

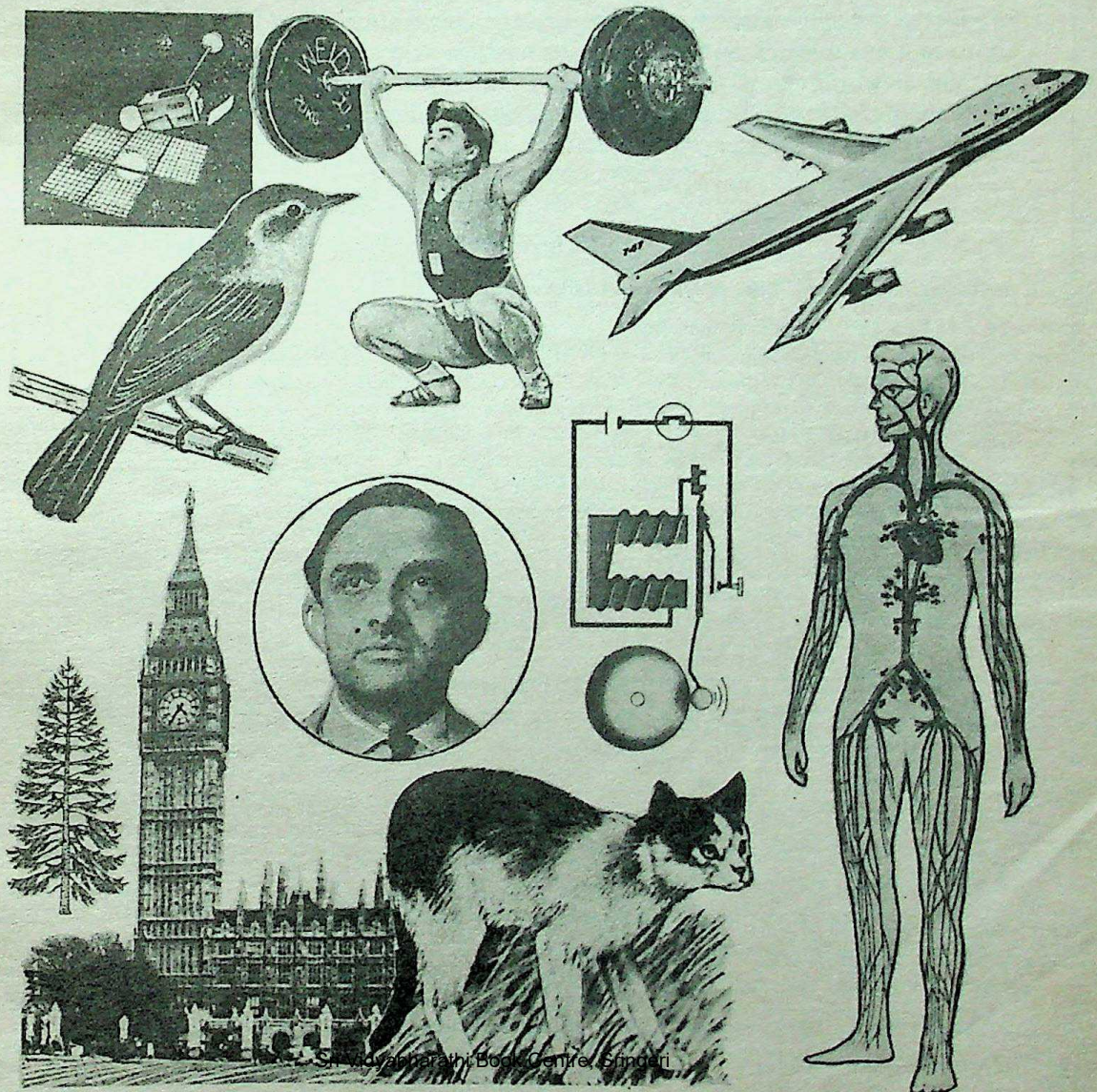
Children's Knowledge Bank

VOL. V



CHILDREN'S KNOWLEDGE BANK

VOL. V



Acknowledgment

There have been three major aspects of our ambitious scheme of '**Children's Knowledge Bank**'

1. To get this series ready in Hindi and publish it in six volumes.
2. To prepare English editions based on original Hindi volumes.
3. And to bring out editions in other Indian languages apart from Hindi and English editions.

Pursuing this project according to the original plan, we have already covered large ground. Five volumes of **Children's Knowledge Bank** in Hindi and English have already been published. First three volumes in different regional languages have also been prepared and others are in the pipeline. Work is progressing to accomplish the project at the earliest.

This project of **Children's Knowledge Bank** is not the result of an individual effort but a product of collective wisdom and experience of specialists in different fields. We have tried to make it as authentic and interesting as possible, and for this, help has been taken from well-known works of international standards and national importance. It is not feasible to list all of them, but we express our gratitude to the following publications for the help in preparing these volumes :

References

ENGLISH: Some of the Selected references consulted—

1. The New Encyclopaedia Britannica in 30 Volumes
2. The New Illustrated Encyclopedia of World History in 2 Volumes; Ed. William L. Langer
3. The Illustrated Encyclopedia of Knowledge in 20 Volumes; Marshall Cavendish
4. The New Junior World Encyclopaedia in 20 Volumes;
5. The Raintree Illustrated Science Encyclopedia in 20 Volumes,
6. The University Desk Encyclopedia: Dutton, Elsevier
7. The Penguin Encyclopedia of Places: W. G. Moore
8. You & Your Health in 3 Volumes: Shryock, Swartout
9. Guinness Book of Records
10. Guinness Facts & Feats Series
11. Reader's Digest Library of Modern Knowledge in 3 Volumes
12. Joy of Knowledge in 14 Volumes: James Mitchell

हिन्दी:

1. हिन्दी विश्वकोश खण्ड 1 से 12 (नागरी प्रचारिणी सभा, वाराणसी)
2. हिन्दी विश्वभारती भाग 1 से 4; जिन्द 6; सं. श्री नारायण चतुर्वेदी, कृ. व. द्विवेदी
3. सचित्र विश्वकोश भाग 1 से 10 (राजपाल एण्ड सन्स, दिल्ली)
4. भारत के पक्षी : मालिम अली
5. भारत की सम्पदा (वैज्ञानिक विश्व कोष) छह खण्ड
6. भारत का वन्य जीवन : ई० पी० जी : अनु० विराज एम. ए.
7. वन्य जीव का संसार : रामेश वेदी
8. शल्य चिकित्सा के वरदान : डा० आत्मप्रकाश एवं कैलाश साह
9. भारतीय सेना तथा युद्ध कला : कर्नल गौतम शर्मा
10. विश्व के प्रमुख खेल तथा खिलाड़ी : योगराज थानी

Apart from the above reference books, help has been taken from many English and Hindi books, dictionaries and Government approved technical series

CHILDREN'S KNOWLEDGE BANK

(Volume V)

BY

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Divided into Five sections it deals 177 questions on General Knowledge, Human Body, Animal & Plant Kingdom, Universe and Space & Sports and Sportsmen

□ How does food get cooked quickly in a pressure cooker? □ How does a thermos flask keep a hot thing hot and cold one cold? □ How does sound travel from one place to another? □ Do cannibals still exist in the world? □ Why does milk appear white? □ Is there any material which does not burn in fire? □ How does paan chewing produce red colour in our mouth? □ Why does the sky appear blue? □ Does black cat bring bad luck? □ Why do objects appear coloured? □ Why does the bread have pores? □ Why does iron get rusty? □ What is fire? □ What is smoke? □ Does any metal exist in liquid state? □ How is iron obtained from earth? □ How is aluminium extracted from the earth? □ What is mirage? □ How is glass made? □ What is diamond? □ Who was Socrates? □ How are millions of substances made from only a few elements? □ How do advertisement boards shine? □ How is light produced by an electric bulb? □ How is electricity produced? □ Which are different states of matter? □ Why do rain bearing clouds appear black? □ Why does it snow? □ How is soil formed? □ What are different forms of energy? □ What is the structure of an atom? □ How do small objects appear enlarged under a microscope? □ What is hydrogen bomb? □ How are radio waves useful for us? □ How was the ball-point pen invented? □ How was the wheel invented? □ How was coffee discovered? □ How did Archimedes detect impurity in the gold crown? □ When did people start drinking tea? □ What is pasteurization? □ When was construction of bridges started? □ How was radium discovered? □ What is Darwin's theory of evolution? □ How can we test the purity of milk? □ Why is the Tower of Pisa leaning? □ What are X-Rays? □ How are icebergs formed? □ Why is Galileo called a great scientist? □ Why is Newton called the father of physics? □ How are valleys formed? □ What is an atom bomb? □ Why is Einstein called the greatest scientist of the present century? □ Can matter be converted into energy? □ What are intra-red radiation? □ Who was Alexander the Great? □ How did the practice of shaking hands begin? □ Why do women have sweet voice? □ Why do we feel hungry? □ Why do tears come out while weeping? □ Why can't we fly like birds? □ How does our body remain warm? □ What makes people sneeze? □ Why do we hiccup? □ Why do some people snore during sleep? □ How polio attacks children? □ Why do we get afflicted by round-worms? □ What is dialysis? □ Why does the blood group vary from person to person? □ Why does human skin have different colours? □ How do female mammals produce milk? □ How do we breathe? □ How do ears detect sound? □ How do the eyes see? □ Why does man become deaf? □ How does man become blind? □ How is urine formed in our body? □ Why do we get tired? □ Why do we perspire? □ Why is cutting of nails painless? □ Why do we feel thirsty? □ How do intoxicants affect our body? □ Why is one of our feet bigger than the other? □ Why do some people walk in their sleep? □ What is pulmonary tuberculosis? □ What is whooping cough? □ How are twins born? □ What determines the sex of a child? □ Why do we have two eyes? □ How do we digest food? □ How do we speak? □ Why do we eat salt? □ Why are some people left-handed? □ What causes headache? □ How do muscles function? □ Why do we stop growing up after a certain age? □ How does the nose smell? □ Why is blood red? □ How did life begin on earth? □ Does any bird eat stone? □ How does a wall lizard get rid of its tail? □ Which animals belong to the cat family? □ How does the firefly glow at night? □ How does the chameleon its colour? □ How does the bat see in the night? □ Do frogs make nests? □ Which animals resemble man? □ Which medicines are obtained from animals? □ Why does the koel (cuckoo) sing only in spring? □ How do parrot and myna speak like us? □ Which are the warm and cold-blooded creatures? □ How fast can the animals run? □ Which animals live the longest? □ Where do frogs disappear in winter? □ How does snake venom affect us? □ Are all the snakes poisonous? □ Is the tongue of some creature longer than its body? 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□ When did wrestling originate? □ Did the game of chess originate in India? □ When did cricket start? □ Why was Dhyan Chand called Hockey Wizard? □ Why is Pele called the Black Diamond of football? □ Was Bradman a run making machine? □ Did the legendary racer Nurmi play a cart? □ Who earned maximum money through sports?

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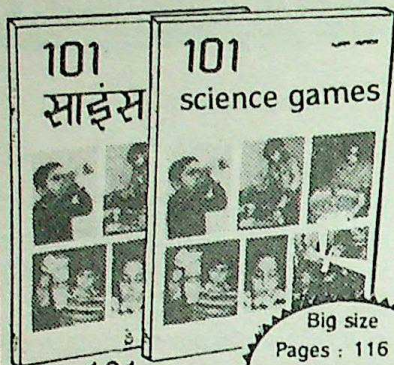
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Section VI—Sports and Sportsmen : □ Which is the oldest game of the world? □ Where did the game of basketball originate? □ What is marathon race? □ When did rowing begin? □ Who have been the famous sportsmen of India? □ What are the popular games of India? □ Which is the national game of America? □ When was swimming included in sports? □ What are the highlights of IXth Asiad, Delhi 1982? □ When did mountaineering become a sport?

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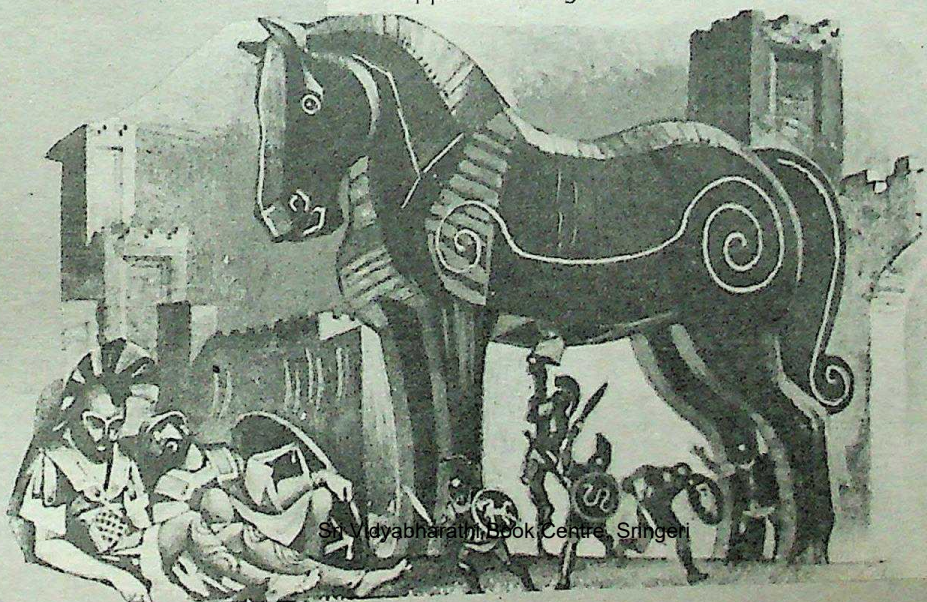
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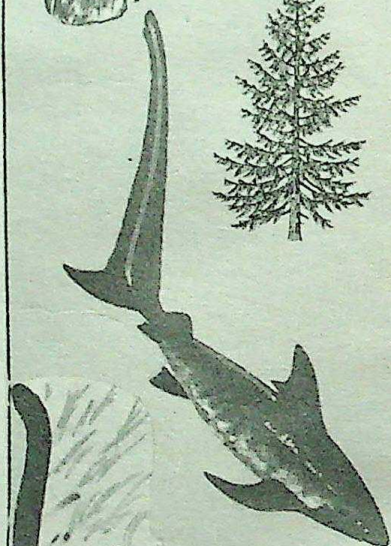
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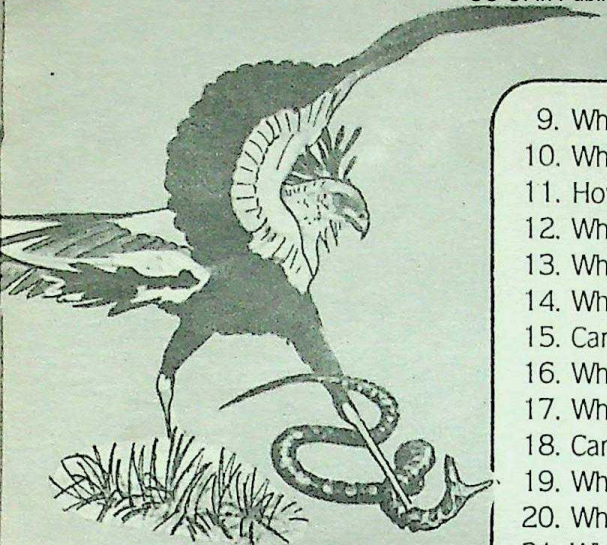


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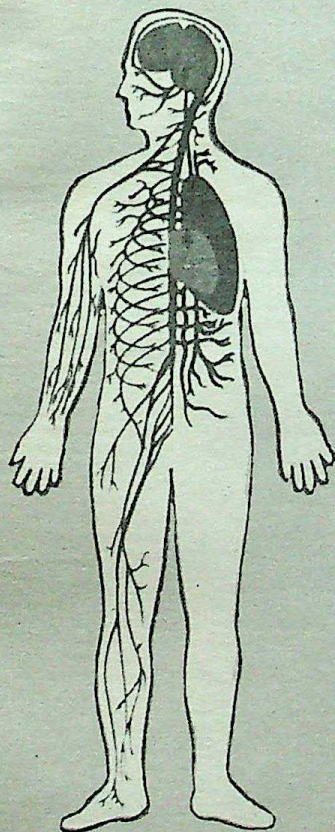
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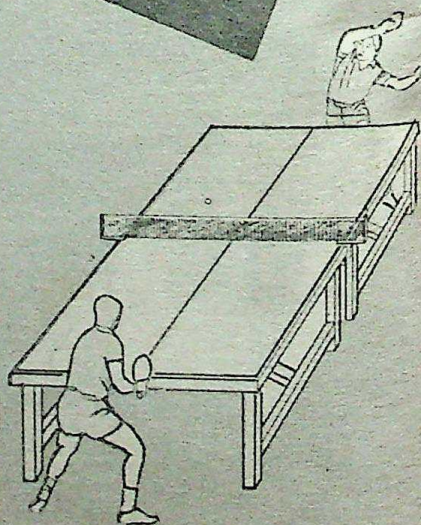
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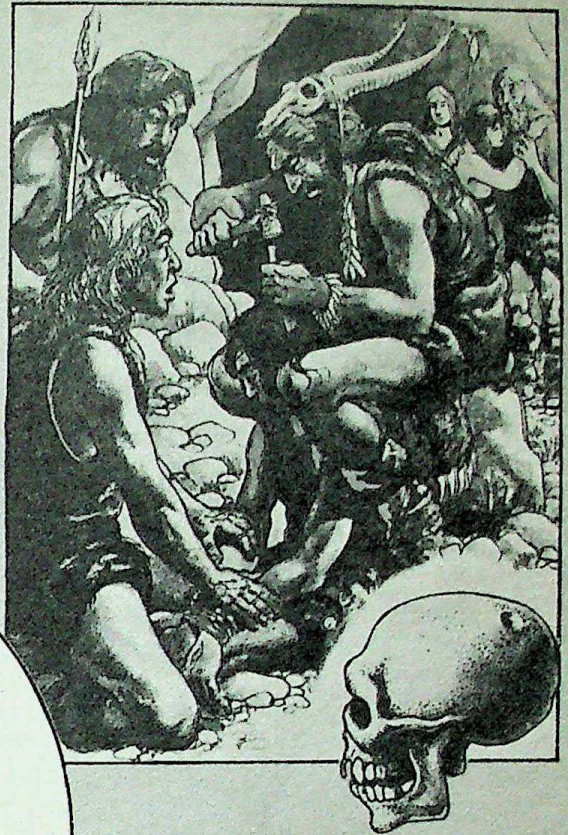
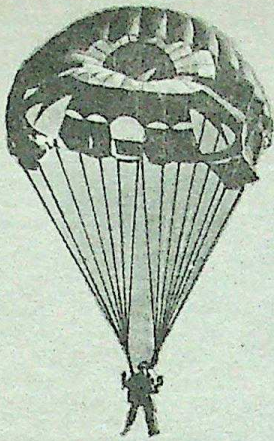
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GENERAL KNOWLEDGE



What is an I. Q. test?

The 'I.Q.' is the abbreviation of a psychological phenomenon called 'intelligence quotient'. It is expressed in a number. I.Q. of an individual is obtained by dividing his mental age (determined by performance on a standardized intelligence test) by his chronological age and multiplying the result by 100. So its formula becomes:

$$I.Q. = \frac{MA (Mental Age)}{CA (Chronological Age)} \times 100$$

The mental age of an individual is determined with the help of different tests. A person whose I.Q. is 130-40 is considered very intelligent, with 100 average and with 70 or below mentally deficient or retarded.

At one time, many psychologists believed that everyone was born with certain fixed amount of intelligence. They felt that intelligence was a trait, like blue eyes or height, and could be measured in a single test. But a French psychologist, Alfred Binet exploded this myth. He worked over this problem in an attempt to develop a test that would help to distinguish between intelligent and stupid children. His first tests were given to French school children in 1905. Later in 1915, these tests were adopted by the German psychologist, William Stern and U.S. psychologist Lewis Terman.

Many psychologists believe that the intelligence tests do not measure intelligence accurately. Many tests seem to measure what someone has learned. They do not measure how quickly or slowly a person can learn. Therefore, these tests do not give a complete picture of the many factors that make up intelligence.

Most scientists define intelligence as the ability to learn or understand. We know that the grasping power of different people is different. They differ in their ability to understand and

remember ideas. They also differ in the use of their knowledge and earlier experiences to solve problems. So, till today there is no fully accepted definition of intelligence.

The scientists are still trying to find out what makes one person more intelligent than the others. It has been concluded that intelligence mainly depends on the heredity and the environment. Every person is born with a certain mental ability. The development of that ability may be activated or slowed down by his or her background.

A child whose family speaks several languages, but depends on outside help for simple mechanical repairs, will probably find learning a new language easier than learning how an automobile engine works. A child who is constantly ridiculed or beaten may develop such a complex that he or she may not be able to develop intellectual abilities fully. Many children who face discrimination because of race or physical defects fail to develop their mental abilities well. From these facts, it is clear that intelligence is not like blue eyes. There is no single trait that can be called intelligence and not a single factor to determine intelligence.

What is the weight of our atmosphere?

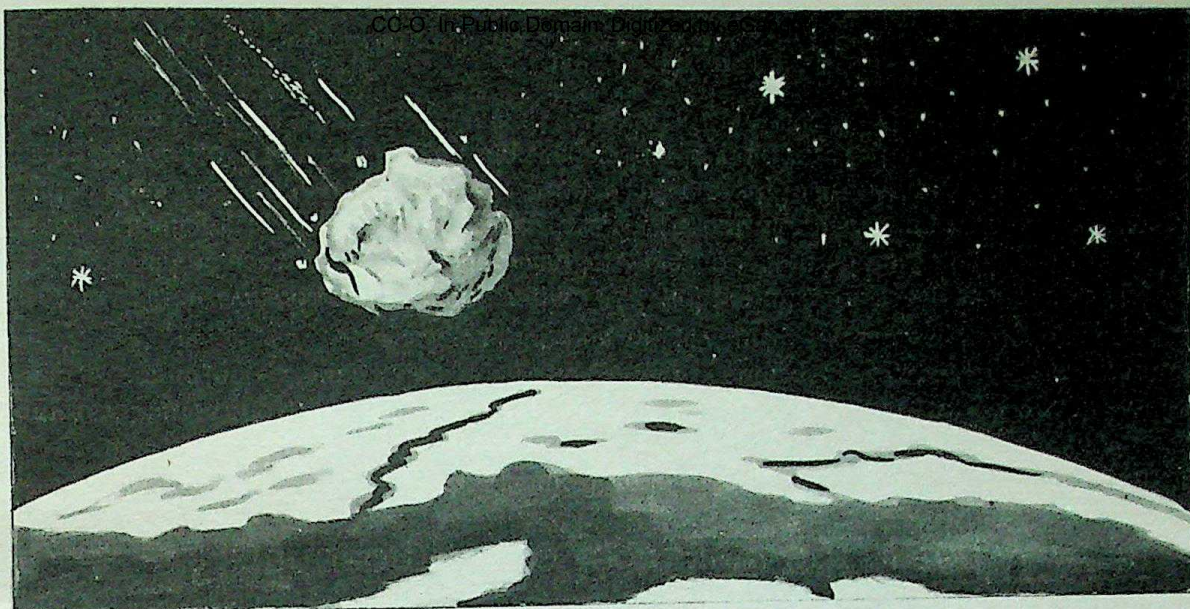
Our earth is surrounded by a blanket of air from all the sides. This enveloping blanket is called atmosphere. The atmosphere consists of a mixture of more than ten gases. In terms of volume nearly 78% of the atmosphere is nitrogen, 20% oxygen and nearly one percent carbon dioxide. The remaining gases include argon, helium, neon, carbon monoxide, ammonia etc. The atmosphere also contains water vapour and dust particles.

Since all these gases are different forms of matter, they exert a downward force on the surface of the earth. Man is rarely conscious of this weight since it presses on him from all directions, and his body is fully adjusted to it. These gases are held by force of gravity. If we take into consideration the masses of these gases and the gravity, we can know the weight of the atmosphere. We know that one mole of nitrogen weighs 28 gms and that of oxygen 32 gms. Mole is the basic unit for measuring the amount of any substance in terms of atoms and molecules.

The total weight of the atmosphere is about 5.5 million billion metric tons (5.5×10^{15} metric tons). More than half of this is upto 3.5 miles from the earth's surface. In fact 97% of its total weight is contained within the first 18 miles.

Now the question arises why the lower atmospheric layers have more weight.

As we rise from the earth's surface, the density of air decreases and hence the atmospheric pressure also decreases. At a height of 3.5 miles (5.5 kms) above ground, the pressure is reduced to half of that at the sea level. The concentration of the gases near the earth's surface is more due to the force of gravity of the earth. As we go above the earth's surface, the force of gravity decreases and hence the gases' density also decreases. That is why the lower layers of the atmosphere contain more weight as compared to upper layers.



How fast do the objects fall?

If you throw a ball up into the air the reaction is obvious. First its speed retards and then it stops for a fraction of a second in the air, and finally starts to fall down to the ground. Here the point to note is that it moves slowly at first, and then picks up speed. Do you know how fast the ball falls and what makes it fall?

The ball falls to the ground because it is pulled towards the earth by the force of gravity. The earth attracts the objects towards its centre with a force known as force of gravity. Due to this force of gravity, falling objects acquire an acceleration. This acceleration is called acceleration due to **gravity**. It is denoted by 'g'.

Acceleration **due** to gravity accelerates the ball roughly by 9.8 metres per sec. per sec. (32 feet per second per second). This means that each second the object would move 9.8 metres faster than the previous second. The speed of the ball at different intervals of time varies as follows.

To begin with, the ball or the falling object is stationary or zero feet per second. At the end of the second it is travelling 9.8 metres (32 feet) per second per second. At the end of 2 seconds it moves 19.6 m per second, and at 3 seconds, 29.4 m per second and so on. In fact, every second the object falls 9.8 metres faster.

The acceleration due to gravity varies with latitude (distance from the equator), altitude and depth. The 'g' is maximum at poles and minimum at the equator. As we go above or under the surface of earth, the value of acceleration due to gravity decreases. At London its value is 32.19 ft. per second per second, at North pole 32.26 ft per second per second and at equator 32.09 ft per second per second. At the sea-level in Washington it is 32.15 ft per second per second or 980.08 cms per second per second. Acceleration due to gravity is defined as the rate of change of velocity of the falling object with respect to time due to force of gravity. Because it is a measure of rate of change of velocity, it is expressed in metres per second per second or feet per second per second.

One of the important points to note about the falling objects is that however heavy they might be, they all fall at the same rate. However, air resistance may have some effect on the speed of falling objects. This fact was demonstrated by the famous scientists Galileo by dropping a heavy cannon ball and a light musket ball at the same time from the leaning tower of pisa. Both the objects arrived at the ground at the same time.

The resistance of the air is the main reason why some objects fall faster than the others. A feather, for example floats slowly downwards because it has relatively large surface for the air to act on. A smooth, pointed bullet will fall faster than a feather because it experiences less resistance of air. In the vacuum both will fall with the same speed because the air resistance would not be there.

How does a Parachute work?

A parachute is an umbrella-like device used for slowing down the descent of a body falling through the atmosphere. Originally conceived for the human use, either as a support or to provide a safe escape from a disabled aircraft, the parachutes have now found wide applications in war and peace; for safely dropping supplies and equipment, as well as personnel. The parachute's invention dates back to almost the same time as that of the balloon although both these inventions took place independent of each other. The first man to demonstrate it in action was Louis-Sebastien Lenormand of France in 1783. Having tied a parachute around himself, Lenormand jumped from a high tower. A few years later, some other French aeronauts jumped with the balloons. Andre-Jacques Garnaria was first to use a parachute on the regular basis demonstrating a number of exhibition jumps including one of about 2400 m in England in 1801.

Early parachutes were made of canvas. Later silk also came to be used. Captain Albert Berry of the U.S. Army made the first successful descent from an airplane in 1912. And by the World War I, parachutes had come to be widely used. In World War II, parachutes were used for a variety of purposes, including landing special troops for combat, infiltrating agents into enemy territories, and dropping of weapons etc.

The modern man-carrying parachutes are made of nylon and assembled in a pack containing the parachute canopy. The average parachute is about 7 to 9 m wide when open. The parachutes for cargo may be as large as 30 m in width. Several forms of parachutes have been developed for special purposes.

Now the question arises how does a parachute work.

A parachute operates on a simple principle. There are two forces that act upon any falling object—air resistance and gravity. The gravity pulls the object quickly toward the earth. But on the other hand the air resists the object's movement. At low speeds, the pull of gravity is much stronger than the resistance of air. Thus air has little effect. But the air resistance



becomes greater as the speed of fall increases. Eventually the object reaches a speed called terminal velocity where air resistance and the pull of gravity are evenly balanced. From that point onwards, the object falls at a constant speed. Large flat surfaces offer a greater area of resistance than the sharp surfaces.

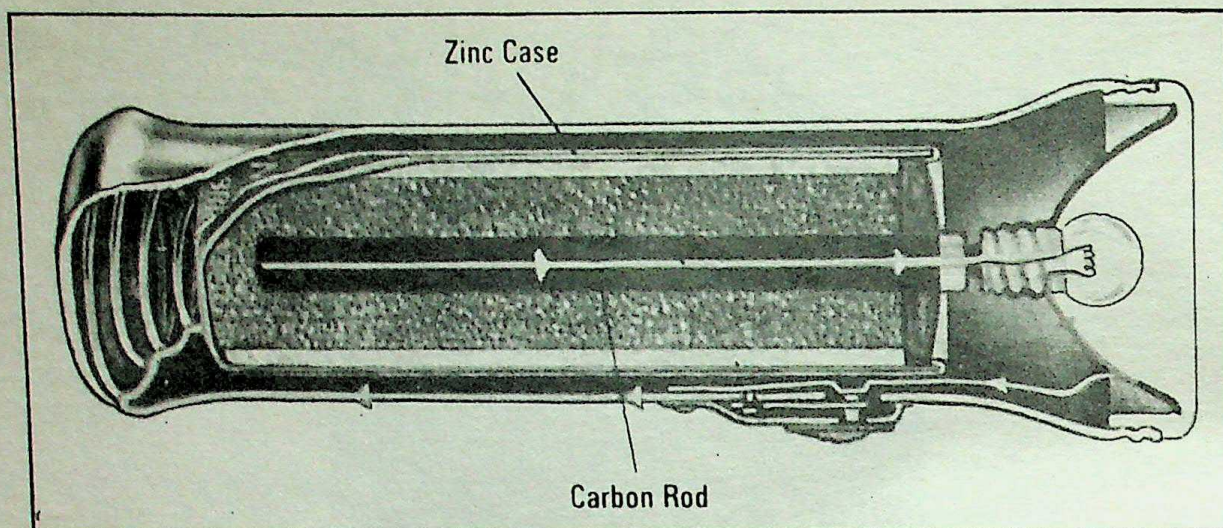
Therefore, an object shaped like a saucer reaches its constant velocity sooner. So it falls more slowly than one shaped like a needle.

As soon as the parachute canopy opens fully, the air slows down the descent of the parachutist so quickly that he is jerked sharply. Now even the parachutes with holes or slots in their canopies have been developed to reduce the force of this opening shocks.

The parachutes descend at a rate of about 5 m (15 ft) per second or slightly faster. But if dropped from less than 150 m above the ground it can prove dangerous because this height does not allow the parachutes to open. The parachutists can control the direction of their descent by pulling on the shrouds.

Nowadays parachutes escaping from supersonic planes have also been developed.

The parachute-jumping has become a popular sport in the United States and Europe. Today there are many clubs and national and international jumping events in which parachutists try to land on small targets on the ground.



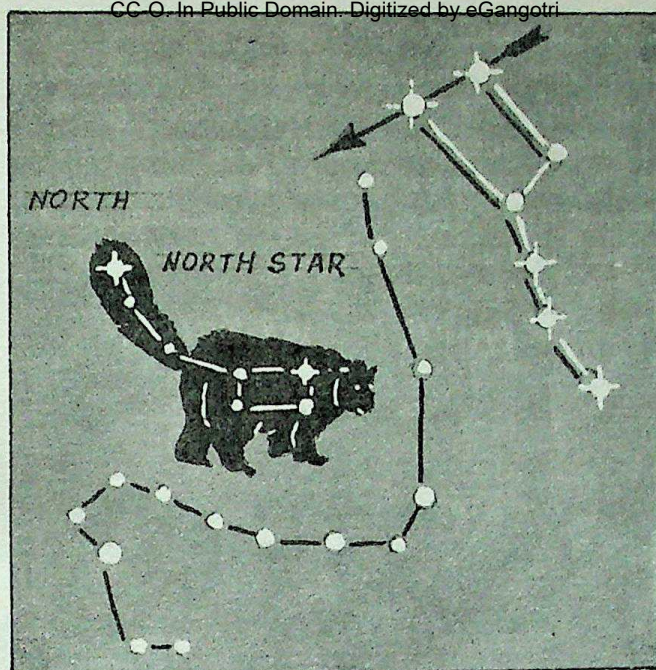
How does a battery torch work?

A battery torch is a portable electrical appliance used for lighting. It has a variety of uses. Doctors use it to examine closely the ears, eyes, noses and mouths of the patients. Do you know how a torch produces light?

The battery torch can be divided into four main parts: the battery, bulb, case and the switch. The battery is in the form of dry cells. Most of the torches make use of two or three dry cells. The body of the torch is fitted with a bulb and dry cells. When the switch of the torch is pressed, the cells get connected to the bulb, and as a result of this the bulb produces light.

The torch produces light by connecting the positive and negative terminals of the dry cells to the bulb. The current runs out at the positive contact through the bulb and back in at the negative contact, so making a complete circuit.

When the switch is moved to the 'on' position a metal piece inside the case touches the positive terminal of the battery, letting the electricity flow out to the bulb. In some other torches, the battery is pushed up so that the positive contact touches the bulb itself. In the battery torch, there is a reflector which directs the light to long distances. The different parts of a torch have been shown in the figure above.

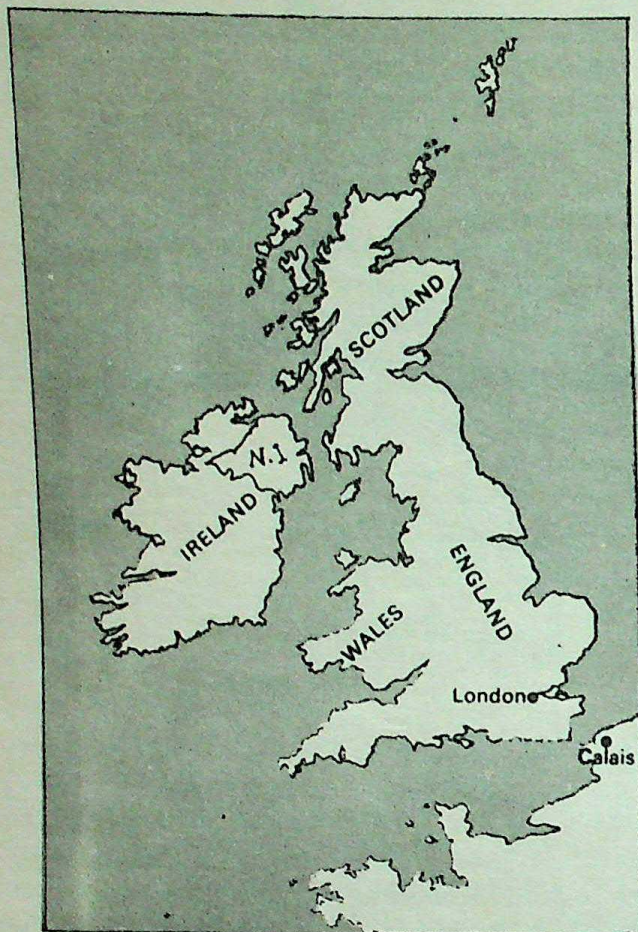


How can we locate the North Star?

For more than a thousand years, the mariners in the Northern Hemisphere have been finding their way by a bright star that is almost exactly in line with the North Pole. This star is called the North Star or the Pole Star or Polaris. Of course, with the invention of the compass, mariners need not to depend upon it anymore. Moreover, the latest radio direction finding has almost eliminated the need for the North Star. But since this star played a very important role in navigation for long time, let us see how we can locate it.

Step out of your house on a clear, cloudless night and look toward the north. You will see a group of seven stars that look like points along a dipper with a curved handle. When you have found such a group or constellation, look around in the same direction for another constellation. It is also shaped like a dipper, but with the handle curving in the opposite manner from that of the first dipper. The larger of these two is the Big Dipper, and the other is the Little Dipper. They are also called: Ursa Major (Big Bear) and Ursa Minor (Little Bear).

Note that the fore part of the bowl of the Big Dipper is made up of two stars. The one at the top of the bowl is called 'Dubhe' and the other one is called 'Merak.' These two stars are known as the pointers because if you draw a line from Merak to Dubhe, and continue the line for a distance equal to about four times the distance between the pointers, you will arrive at a bright star that is the one we are seeking—the North Star.



When was the United Kingdom formed?

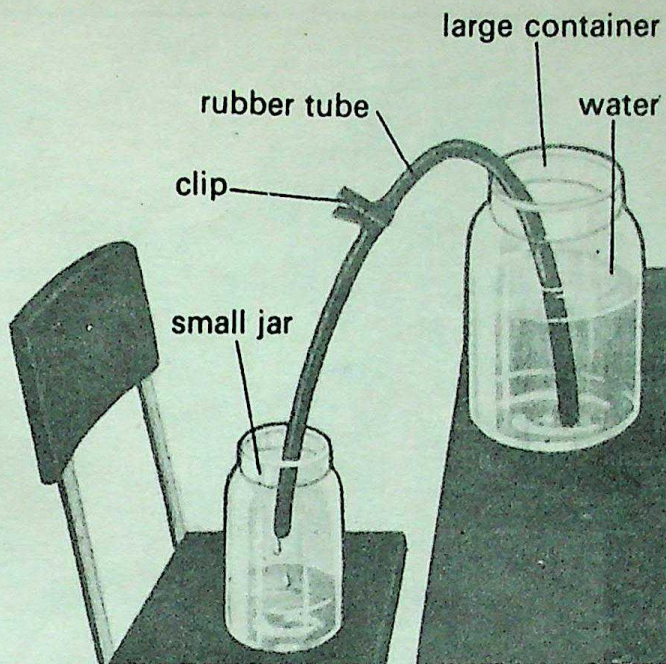
The United Kingdom comprises England, Scotland, Wales and the Northern Ireland. It was formed in 1801 when the 'Act of Union' brought Ireland under the same parliament as England, Scotland and Wales. The official name of the country was changed to the 'United Kingdom of Great Britain and Ireland'. But 26 Irish counties left the Union in 1922 and formed the Irish Free State, now called the Republic of Ireland. Five years later the 'Royal and Parliamentary Titles Act' named the union as the United Kingdom of Great Britain and Northern Ireland.

Wales was the first to unite with England, having been subdued by King Edward I in 1282. The heir to the English throne has been known as the Prince of Wales ever since Edward gave the title to his infant in 1301. But it was not until 1536, during the reign of Henry VIII, a Tudor monarch of Welsh descent, that an Act of Union peacefully incorporated the principality into the Kingdom.

The name Great Britain came into currency after the king James VI of Scotland succeeded to the English throne in 1603 as James I, and United the two crowns—though not the nations. Another 'Act of Union' brought England and Scotland under one government in 1707.

The Union flag of the present Kingdom is composed of the flag of England (white with an upright red cross), the flag of Scotland (blue with a diagonal white cross) and the red diagonal cross of Ireland.

On May 29, 1953, under the Royal Titles Act, a proclamation was issued which gave the Queen the title 'Elizabeth the second, by the Grace of God, of the United Kingdom of Great Britain and Northern Ireland and of her other Realms and Territories Queen, Head of the commonwealth, Defender of the faith.'



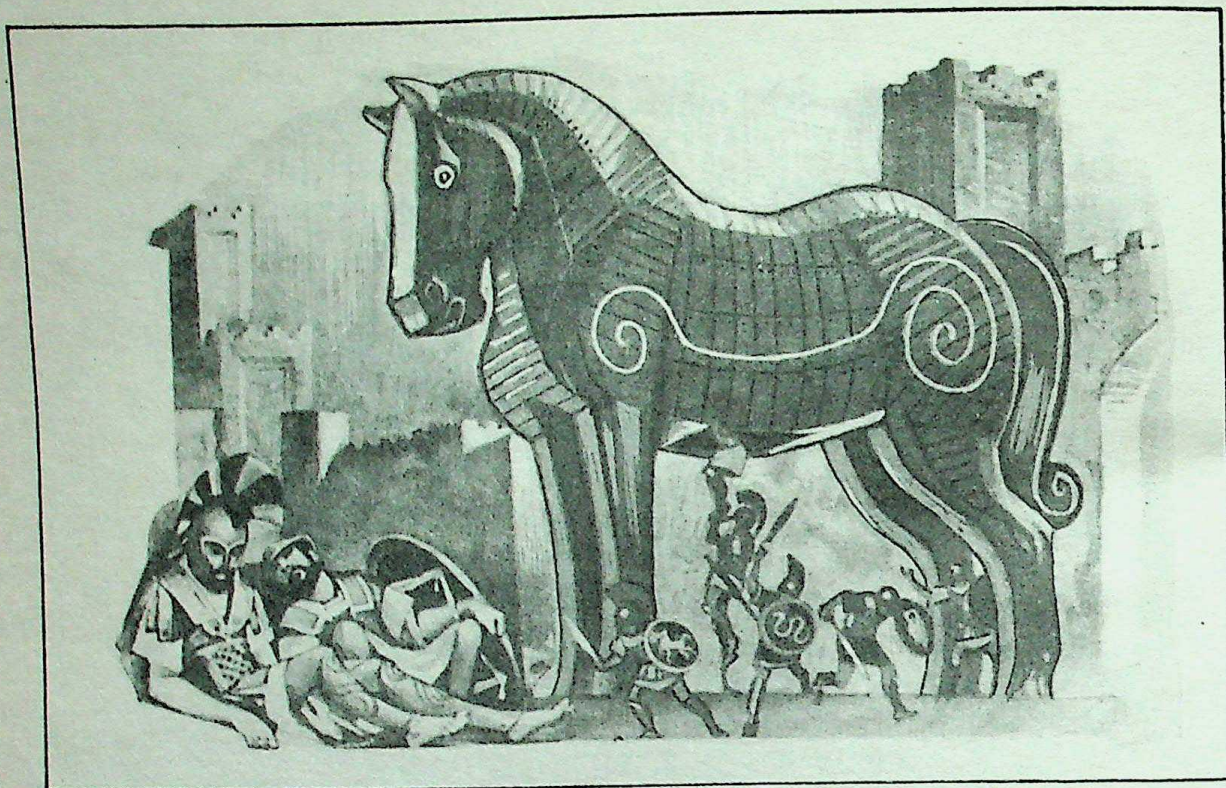
How does a siphon work?

A siphon is a device used to transfer a liquid from one container to another. It is shaped like a bent tube with arms of unequal length.

A rubber or plastic tube is normally used as a siphon. Shaped like 'U' it has arms of unequal length. The end of the arm is placed in a container, and the liquid is sucked up into the tube. A finger is quickly placed on the open end of the tube to keep the liquid in it. Keeping one end of the tube in the liquid, the open end is then placed in a second container, which should be at a lower level than the first container. You will find that soon the liquid starts flowing from the first container to the second.

Now the question arises what makes the liquid flow from one container to the other.

It is the air pressure which forces the liquid to flow from the first container to the second, provided the level of the liquid in the first container is higher than that in the second one. Because of the difference in the lengths of the arms, a pressure difference causes the liquid to move. The liquid flows from one container to the other till the level of the liquid in the two containers becomes the same. Since the upper liquid is usually exposed to the atmosphere, the maximum elevation over which a water siphon will function is about 9 m (30 ft), the water equivalent of atmospheric pressure.



What was the Trojan Horse?

We are sure you have heard about Trojan War. It was fought between the early Greeks and the people of Troy (now in Turkey). The scene of this great battle was the city of Troy in about 1230 BC.

According to the legend, the war started about 1240 BC when Paris, the son of the King of Troy, carried off Helen, the beautiful wife of King Menelaus of Sparta, to home with him. Menelaus' brother, the great king Agamemnon of Argos, summoned all the other kings of Greek cities, and set off with a thousand ships to bring Helen back. For ten years the Greeks besieged Troy without success. Then they devised an ingenious scheme to defeat the enemy.

They built a great wooden horse which was called the Trojan horse. The Greeks concealed a raiding party inside and left it outside the city walls. The horse was built by Epeius, a master carpenter and pugilist. The Greeks, pretending to retreat sailed to the nearby Island of Tenedos. They left behind Sinon, who persuaded the Trojans that the horse was an offering to Athena to make Troy impregnable. The Trojans brought the horse inside the city walls. What they did not know was that the horse was full of Greek soldiers. At the midnight they burst out, opened the city gates and let in the rest of the Greek army. They killed all the Trojans they could find, and set fire to the city. It was completely destroyed.

The legend of the Trojan war has been the subject of a famous epic by the blind Greek poet, Homer, which is called 'The Iliad'. Ilium is another name for Troy. The story is told at length in IInd book of the 'Aeneid' and is also touched upon in the 'Odyssey'.

What is Fool's gold?

Fool's gold is a naturally occurring iron disulphide mineral. It is also called iron pyrites. Because of its brassy-yellow colour with a brilliant lusture, it is often mistaken for gold and has been given the nick name, "fool's gold". Pyrites may be distinguished from gold by its much higher degree of hardness and brittleness.

The pyrite has been named after the Greek word 'pyr' (fire) because it emits sparks when struck by steel. Nodules of pyrite have been found in prehistoric burial mounds which suggests that it was used as a primitive means of producing fire.

Pure pyrite contains 46.67 percent iron and 53.33 per cent sulphur. This mineral is widely distributed and occurs under extremely varied conditions of mineral formation. It occurs in large deposits in contact metamorphic rocks. Large deposits of pyrite are found in Spain, the United States, Italy, Norway, Japan, Canada, Portugal and Czechoslovakia.

The pyrite is an important source of sulphuric acid. It is also used commercially as a source of sulphur and sulphur dioxide. It contains such a high percentage of sulphur that it will sustain its own combustion without the aid of an external heat source. Because of the availability of much better sources of iron, the pyrite is not used as an iron ore.

What is the guerrilla warfare?

The guerrilla warfare is waged by irregular forces in generally small-scale operations, often in enemy held territories. The word 'Guerrilla' is a Spanish word that means 'little war'. The word came into use during the Duke of Wellington's campaigns to help the Spanish - Portuguese irregulars or guerrillas drive the French out of the Iberian peninsula. Lawrence of Arabia, who as a great force behind the guerrillas in their struggle against the Turks in the first World War, once remarked, "Guerrilla war is much more intellectual than a bayonet charge".

The importance of guerrilla warfare has varied from time to time in the last two hundred years. After World War II, it came to play a significant role in what has been termed as a revolutionary warfare. Since the World War II, the guerrilla warfares have been waged against the enemies in many countries. Guerrilla warfare was used with considerable success in Cyprus, Kenya and Algeria. By the early 1970's widespread guerrilla activity was continuing in Indochina (including South Vietnam, Laos, Cambodia and Thailand). It was used in Bangla Desh and Cuba also.

The guerrillas are usually a fighting force, non-descript in dress, equipped with unconventional weapons and ammunition. They are an extremely mobile force. They use a wide variety of weapons, some self-manufactured, some captured and some supplied by friendly countries. These include home-made rifles, hand grenades and claymore mines.



The tactical organisation of guerrilla units varies according to operational demands. They may be in a squad of 11, 4 or 5 or more.

The most disturbing aspect of guerrilla warfare is the use of terrorism. It could mean assassination of important people or throwing of a hand grenade into crowds, or indiscriminate bombing. The use of sabotage and terrorism is a part of their system of fighting. Terror is used to focus world attention on the rebel cause, to eliminate opposition leaders and to paralyse normal government activity.

The guerrilla force cannot fight all the time. They must control safe areas where they can retire for rest, recuperation and repair of arms, clothing and equipment, and where recruits can be indoctrinated, trained and equipped.

Above you can see the photograph of the most popular modern guerrilla leader, Che Guevara of Cuba. Other leaders were Lenin, Trotsky, Mao, Tito, Ho Chi Minh etc.

Which British Sovereign
had the longest reign?



Queen Victoria had the longest reign among all the British monarchs. She was born in London on May 24, 1819. She was the only child of Edward Augustus of Kent. She succeeded to the British throne on the death of her uncle, King William IV on June 20, 1837, when she was only 18 years old. She ruled for sixty three years and seven months and died on January 22, 1901.

Victoria was the queen of Great Britain and Ireland and Empress of India. Her reign was eventful, as well as long. During her reign Britain became more powerful and prosperous and built up a large empire overseas. It was an epoch marked by great inventions and of industrial progress.

In 1840, Queen Victoria married her cousin Prince Albert of Saxe-Coburg-Gotha. She was deeply devoted to her husband and relied heavily on his advice. When Albert died a premature death in 1861, Queen Victoria was so distressed that she withdrew from all social occasions, and led a solitary life for a number of years. But despite this she took an active interest in the administrative affairs and took all the important decisions herself.

She had nine children, who married into the other royal families of Europe. So, most of the European royal families are now related. In the latter period she sided with the conservative party.

The present queen, Elizabeth II is the great-great-grand-daughter of Queen Victoria.

Sri Vidyabharathi Book Centre, Sringeri

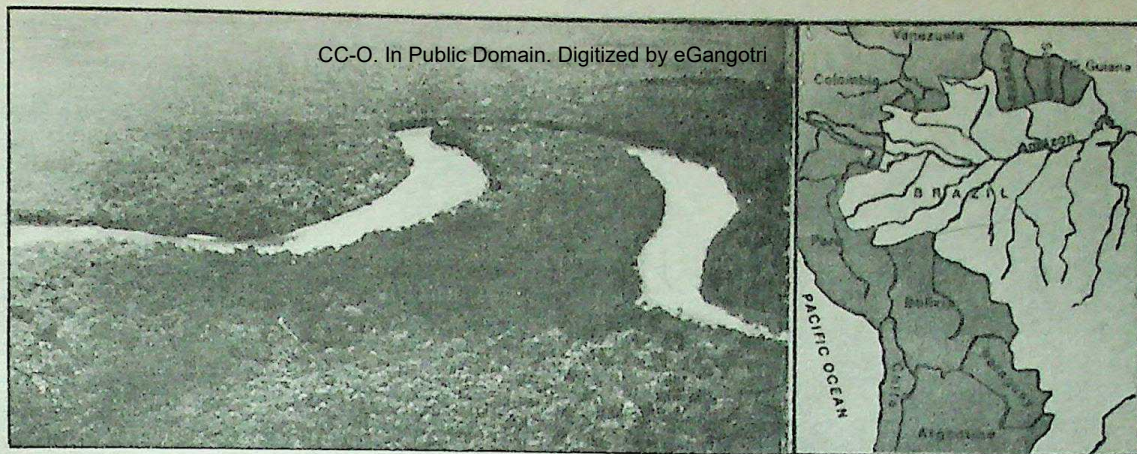


What is an opera?

The English word opera is derived from the Italian expression 'Opera in musica', which means 'a musical work'. Opera is, in fact, a mixture of music and drama i.e. it's basically an extended dramatic composition in which all parts are sung to instrumental accompaniments. It is essentially a refined kind of entertainment and has attracted audiences for nearly five centuries. Complex in nature it is a costly entertainment. The story of the opera is sung, usually in the language in which it was originally written, and this can make it difficult to follow.

The opera originated in Florence, Italy, about 1582 when the classicists were trying to revive Greek drama—which had music as well as words. The first opera house was opened in Venice in 1637. It soon spread from Italy to France and Germany before 1650 but it did not catch popular imagination for quite a long time. Gradually it spread to other countries of the world such as Austria, England, Russia, Czechoslovakia, Hungary, Poland, Spain, USA and China.

The operas performed today are the compositions of some of the greatest musicians of the world. They include: Rellini, Verdi, Puccini (Italian) Mozart (Austrian and German), Wagner (German); Gounod and Bizet (French), Tchaikovsky (Russian), Glinka, Borodin, Rimski-Korsakov (Russian).



Which is the largest river in the world?

The Nile is the longest river in the world, but Amazon is the largest of all. It is the second longest river in the world. It flows 6448 kms from across Northern Brazil to the Atlantic Ocean. It is formed by two major headstreams—the Marañón and Ucayali—in the Andes of Peru.

The Amazon was first discovered in 1499 by Vicente Yanez Pinzon—a Spanish sea captain who was a part of Columbus' crew on his great voyage. As Pinzon was sailing out of sight off the coast, he discovered that he was voyaging through fresh water. He moved shorewards to investigate and anchored in the mouth of the vast river.

One of the most intriguing things about the Amazon is that its tributaries are distinctly of different colours. The true source of the main river is 5240 metres above the sea-level in Peruvian Andes, and this starts off as white or dirty yellow. All the tributaries to the Amazon which run through the Andes are similar in colour as they carry heavy quantities of whitish soil in their waters. Many of its other tributaries which originate in northwest Brazil and Venezuela are apparently black in colour. In fact, these rivers are very clear and dark red in colour because they flow over ancient bare rock formations, and are relatively free of sediment but laden with iron.

The Amazon basin has a catchment area of nearly 3 million square miles that's about four tenths of the total area of South America.

In general, there is one flood season every year. During August and September, the snow of the Andes begins to melt, but the effect of this is only felt in November when the upper Amazon begins to rise. The floods reach the lower river between January and May which is also the wettest time of the year. The rise in water-level is about 30 to 50 ft. in the middle and lower parts of the Amazon.

Although the Amazon lowlands make up nearly half the total area of Brazil, these are occupied by only 10% of the total population of the country. Most of the people live close to the banks of the navigable rivers. There are many hundreds of thousands of square miles which are occupied only by a few primitive Indian tribes. Large areas are unmapped and virtually unexplored.

The Amazon is sufficiently deep for ocean-going vessels to sail upstream to Manaus, and some can even reach Iquitos in the eastern Peru. The river steamers can also sail on the Amazon and its tributaries.



Who was Gautama Buddha?

The word Buddha literally means the 'Enlightened One'. This was the title given to Siddhartha Gautama. He became the founder of the religion called Buddhism.

The Buddha was born as a prince in the 6th century B.C. in a warrior community of Nepal called 'Sakyas'. Although brought up in great luxury, he did not show any attachment to the material delights. Even when young, he had a sensitive and philosophical temperament. Though he had everything necessary for worldly life, he was somehow dissatisfied.

One day Siddhartha went in his chariot outside his palace grounds into the town. There he saw three sights he had never seen before. He saw a sick man, an old man and a dead man.

These had a deep impact on his mind and made him sad. He could see clearly the world contained suffering, sickness, old age and death.

He at once decided to discover the real nature of suffering in the world and how it could be cured. At that time Siddhartha was 29 years old. He was married and father of a son. In the pursuit of his goal one night without telling anyone he crept out of his palace and went off into the forest. He spent several years studying under various teachers, but none could impart him the wisdom he was searching for. Finally travelling from one place to another he reached a place in North India now called Bodhi Gaya. There he sat for many days under a tree in deep meditation, until suddenly one morning he had the wonderful experience. The light that shone in him was the enlightenment, he was searching for. He spent the rest of his life trying to show how others could follow in his footsteps, and experience the divine experience which brings the end of suffering.

Buddha delivered his first sermon at Benares on the banks of river Ganges. Here he outlined the beliefs which have been the guiding principles of Buddhism. According to Buddha the material world cannot give final happiness to man. One should not be either completely self-indulgent nor too strict with oneself. One should follow the middle path. In the words of Buddha it is the 'Noble Eightfold' path, because it enumerates eight main principles which one should observe. These are (i) right understanding (ii) right thought (iii) right speech (iv) right action, (v) right livelihood (vi) right effort (vii) right mindfulness and (viii) right concentration. He gave the symbol of Buddhism known as the Wheel of Doctrine. The eight spokes represent the eight paths of the Nirvana.

Gautama Buddha died at the age of 80 near Benaras. After him Buddhism spread to many countries. The main countries where it is prevalent include Burma, Thailand, Ceylon and Japan. There are about 1,77,000 Buddhists in North America.

What were the causes of Russian revolution?

In the 19th century, almost whole of Europe was undergoing great social, economic and political upheavals. France had become a republic and England a constitutional monarchy. The feudal aristocracy was on the decline and the new rulers were the industrialists and traders. Russia, however, was still living in 'the old times' under the autocratic rule of the Czars, the Russian emperors. The peasants and workers were hard-pressed and led a hand-to-mouth existence.



Due to the absence of a middle class, the industrialization began late in Russia, in the second half of the 19th century. The Russian capitalists competed with foreign investors by reducing workers' wages. This added to the miseries of the workers. The workers had no political rights and no means of gaining even minor reforms. The Czar Nicholas II in whose reign the Revolution occurred, still believed in the divine right of kings. He considered the exercise of absolutism as his sacred duty. The only people who supported the Czar were the nobility and the upper strata of the clergy. The rest of the population in the vast Russian empire was hostile. The bureaucracy that the Czars had built was top heavy, inflexible and inefficient, the members being recruited from the privileged classes rather than on the basis of calibre.

The Russian Czars had a vast empire in Europe and Asia. In these countries they forced Russian language on people and effected fundamental changes in their cultures. This brought him into conflict with other imperialist powers.

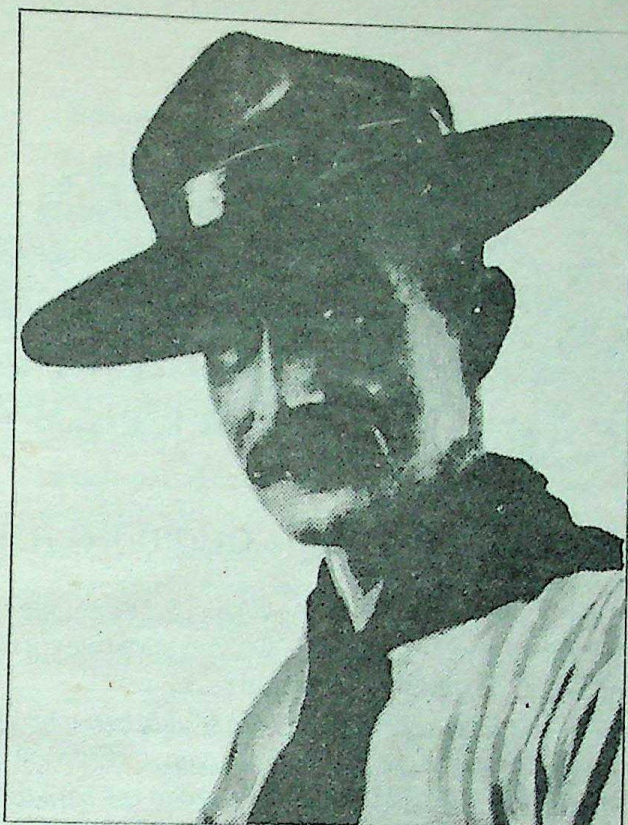
The downtrodden workers and peasants got inspired by the teachings of Marx regarding socialism. They rose in revolt in 1917 against the despotism of the Czar, Nicholas II. The Czar's government machinery failed utterly as the army, which was ordered to fire on workers, refused to do so and rather sided with the workers. On March 12, 1917, the capital city of St. Petersburg (renamed Petrograd and now Leningrad) fell into the hands of the revolutionaries. Soon the revolutionaries took over Moscow. The Czar gave up his throne and Lenin emerged as the strong man of Russia. Under his leadership, the Bolshevik Party put forward specific policies to end the war and transfer the land to the peasants.

This revolution established a government of the working people. Consequently Russia achieved phenomenal progress in the domain of agriculture and industry. The old social order gave way to a new society in which all were free, equal and entitled to fair wages.

When did the scout movement begin?

The scout movement was formed in 1903 after the appearance of a book, 'Scouting for Boys'. This was a book written by the then Inspector General of Cavalry in the British Army, Lt. Col. Sir Robert Baden Powell. Although the author's basic intention was only to formulate certain guiding principles to be followed by the existing youth organizations, it soon became evident that a new movement had begun. In fact, Baden Powell is said to be the father of scouting movement.

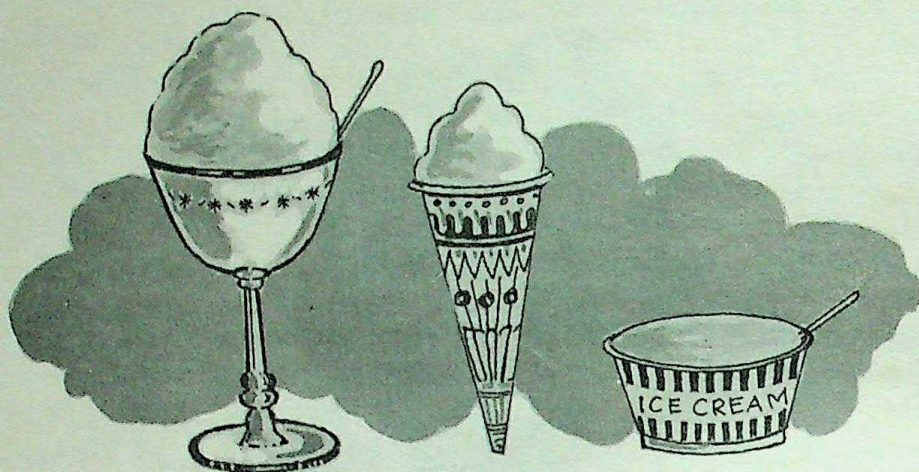
Baden Powell had held an experimental camp on Brownsea Island in Poole harbour, Dorset and put his ideas into practice. He believed they should organize themselves into small natural groups of six or seven under a boy leader. Their training should add another dimension to their education by including mapping, signalling, rope knotting, first aid and all the other skills needed in camping and similar outdoor activities in which self-reliance is important.



A boy becomes a scout by joining a scout troop any time between the age of 11 and 16. Before being accepted as a scout, a boy has to promise to do his duty to God and his country or sovereign, help other people at all times and to obey the scout Law. The Scout Laws are: (i) a scout is to be trusted (ii) a scout is loyal (iii) a scout is friendly and considerate (iv) a scout is a brother to all scouts (v) a scout has courage in all difficulties (vi) a scout makes good use of his time and cares for others' possessions and property (vii) a scout has respect for himself and for others.

Almost all of the scout activities are based on the patrol which is the primary unit in scouting. The patrol leader takes part in the planning and running of activities. This does not mean that each patrol works only on its own. The patrols regularly come together for Troop Meetings and activities. The scouts from different Patrols may even work for a particular Proficiency Badge in which they share a common interest. The traditional scouting activities are hiking, camping and pioneering. Apart from these, activities include cyclo-cross, radio construction, water and snow ski-ing, trampoling, home decorating, folk groups and so on.

With more than 13 million members in over 150 countries, scouting today is a world-wide movement. There is a Boy Scouts World Committee which consists of 12 men from 12 countries. It is elected by the Boy Scouts World Conference which is composed of all National Member Associations. The conference is world scout's General Assembly and meets every two years.



Where did ice-cream originate from?

Today ice-cream is a very popular sweet dish. While earlier people had it only during the summer, today it is consumed in the winters also. Do you know where did ice-cream originate from and how it spread to other parts of the world?

The ice-cream originated in China. From there it was brought to Italy by the famous explorer Marco Polo some 700 years ago. Marco Polo went to China along with his father and brother in 1271 on a trading expedition. He was surprised to see a frozen food being sold from handcarts on the streets of Peking. It was actually frozen milk, sometimes flavoured with fruit juices. Marco Polo was offered it as a gift. He took it with him to Italy. From Italy, the idea got across France. In the year 1533, Catherine de Medici of Italy went to France and married the second son of Francis I of France. Catherine took with her a large retinue of cooks. It were they who introduced the new delicacy to the French, who soon discovered how delicious it was.

Interestingly again it was a bride who later brought it to England. This was Henrietta Maria of France, who married Charles I in 1630. The secret of ice cream preparation was brought to England by her cook.

Soon ice-cream spread all over the world including the U.S.A. The first wholesale factory for the manufacture of ice-cream was started in Baltimore, Maryland in 1851. The real development of the ice-cream, and the ice-cream business started flourishing only after 1900 with the development of refrigeration.

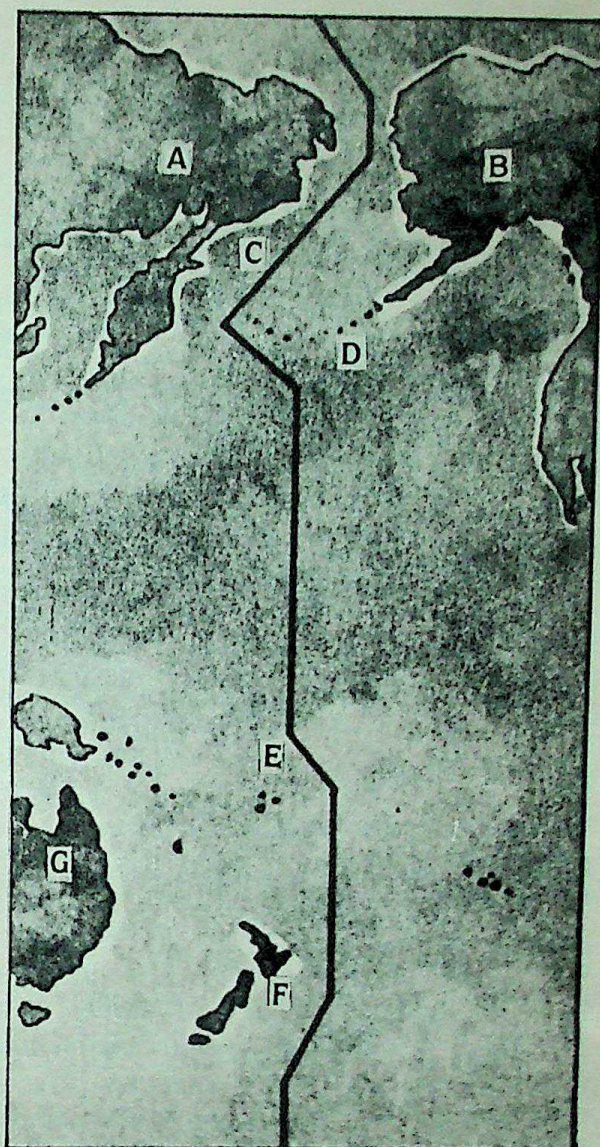
The basis of all ice-cream is cream, milk, sugar and sometimes even eggs. Vanilla, Chocolate, Berries, fruit ingredients and nuts are added as flavours. The ice-cream usually contains 20 to 25% cream and milk products, 15% sugar, flavour in small quantities and small amount of stabilizer. The stabilizer is used in order to retain the smoothness of the ice-cream by preventing the formation of coarse ice crystals. Pure food gelatine is usually used for this purpose.

The ice-cream contains calcium, protein and vitamins A and B.

What is the date line?

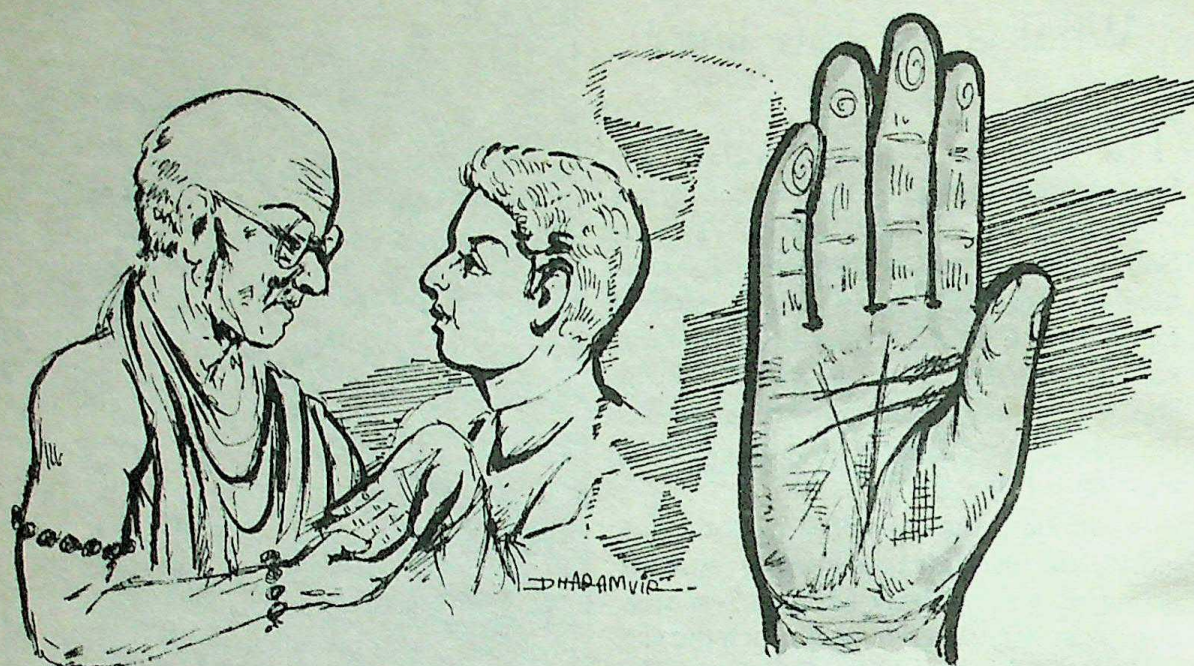
The date line, usually called the International Date Line, is an imaginary line extending between the North Pole and the South Pole. It passes through the Pacific Ocean where, according to international agreement, the date changes. As the earth rotates, each day first begins and ends on the line. A traveller going east over the line sets his calendar back one day, and one going west adds one day.

The date line is a consequence of the worldwide use of time-keeping systems arranged so that local noon corresponds approximately to the time at which the sun crosses the local meridian of longitude. The line is necessary because the earth is divided, longitudinally into 24 one-hour time zones (15 degrees longitude each) which make one full day on the earth. Since the earth rotates eastward, the time on the clock progresses westward round the world. Thus 12 O'clock noon occurs in London (0 degree longitude) five hours before it does in Washington D.C. (75 degrees west of London), and eight hours before at San Francisco (120 degrees west of London). So, when it is noon in London, it is midnight 180 degrees to the west.



On either side of the 180th meridian, the time is the same. Let us take the example of a traveller going completely around the earth, carrying a clock that he advanced or retarded by one hour whenever he entered a new time zone, and a calendar that he advanced by one day whenever his clock indicated midnight. When he returns to his starting point, he would find that the date according to his calculations was different by one day from that kept by persons who had remained at the starting point. The date line provides a standard means of making the needed readjustment. That's why a traveller moving eastward across the line sets his calendar back one day and one travelling westward sets his calendar a day ahead.

The date line has some variations from the 180th meridian to allow for land areas or islands. The line bulges eastward through Bering Strait to take in eastern Siberia and then westward to include the Aleutian Islands with Alaska. South of the equator, it bulges eastwards again to allow various island groups to have the same day as New Zealand.



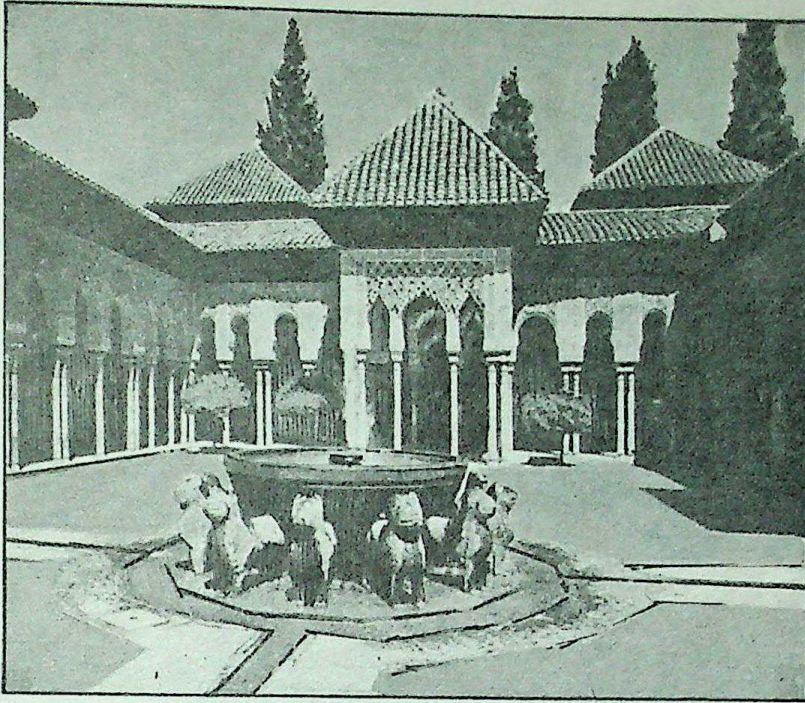
What is Palmistry?

The popular belief that a man's fortune could be told by reading the lines of his palms began some 2500 years ago in India, and then spread to other countries. To begin with the fortunetellers also showed an interest in reading the lines on the soles, but found hands were easier to get at. The science of palm-reading is called Palmistry, and deals with character reading and divination of the future by the interpretation of lines and undulations on the palm of the hand. Now the question arises, do the lines on the palm really tell future.

Although there is no scientific basis for the contention that these structures have psychic or occult predictive meaning, the human hand does show evidence of the person's occupation, habits and temperament, interests and personality.

According to the ancient palmists, the top line was connected to the heart, and showed the ability to love. The one under this was connected to the brain and was called the head line; while the line of fate cut across these two. The curving line below the head line was supposed to be the life line. Its length indicated the age of the person i.e. how long he would actually live. There were many other lines that revealed different aspects of life.

The palmists of today also have the same names for the lines, and read their meaning in the similar fashion as the ancient fortunetellers did. If a palmists prediction comes true it is remembered, while the wrong predictions are forgotten. Predictions based on palmistry, as a matter of fact, do not have any scientific 'basis' and so can't be wholly believed. Like this the other methods of fortunetelling are also only partially reliable.



Where is the Alhambra?

The Alhambra is a palace and fortress at Granada in Spain overlooking the River Darro. It was built by the Moors who occupied Spain in the Middle Ages. The Moors were the inhabitants of Mauretania, an African province of the Roman Empire. Today it is known as Morocco. The Alhambra was begun in 1248 and completed in 1354.

In Arabic the word 'Alhambra' means red. So in this case it is probably derived from the colour of the bricks of which the outer walls are built. The palace was built in the reigns of Al Ahmar and his successors.

After the year 1492 when the Moors were driven out, much of the interior was effaced and the furniture was ruined. Charles V, who ruled in Spain (1516-56) rebuilt its portions in the Renaissance style and destroyed part of the Alhambra to build an Italianate palace designed by Pedro de Machuca in 1526. In 1812 some of the towers were blown up by the French during the Napoleonic wars, and in 1821 an earthquake caused further damage. The restoration of the building was undertaken in 1828 and continues till today. Today only some splendid remnants of its former glory are to be seen.

The principal courts of the palace include the court of the Myrtles and the court of the lions. The latter has been named thus because in the centre is the fountain of lions, an alabaster basin supported by the figures of 12 white marble lions, emblems of strength and courage. The most important parts of the Alhambra are the 'Hall of Ambassadors', a specially grand reception room, and the 'Hall of the Two Sisters' with its outstanding example of stalactite work.

Of the outlying buildings, the most important is the Generalife. This villa probably dates back to the end of the 13th century.



Why do people have Christmas Trees?

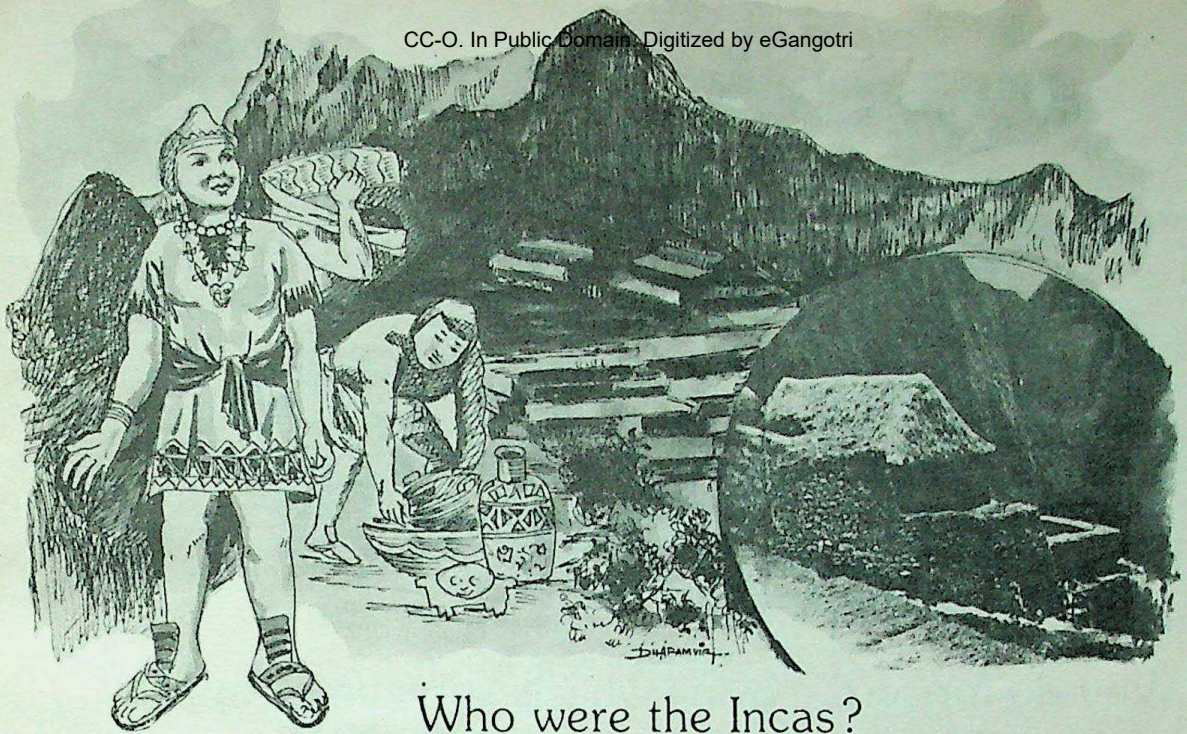
The Christmas tree is an evergreen tree, usually a balsam or douglas fir, decorated with lights and ornaments as a part of Christmas festivities. It has its roots in the customs of ancient Egyptians, Chinese and Hebrew who treated the wreaths and garlands of evergreen trees as symbol of eternal life. The tree worship, common among the pagan Europeans, survived even after their conversion to Christianity. These included the customs of decorating their houses and bars with evergreen trees at the new year to scare away the devil and to set up a tree for the birds around this time.

The modern Christmas tree originated in western Germany. The main prop used in a popular medieval play about Adam and Eve was a fir tree hung with apples (paradise tree) representing the Garden of Eden. The Germans set up a 'Paradise Tree', in their homes on December 24, the religious feast day of Adam and Eve. They hung wafers on it. They also used Christmas pyramid, a triangular construction of wood, with shelves to hold Christmas figurines, candles and a star. By the 16th century the Christmas pyramid and paradise tree had merged and become the modern Christmas Tree.

The custom became widespread among the German Lutherans by the 18th Century. Later it was also introduced in England in the mid 19th century by the German Prince Albert, the husband of Queen Victoria.

The Victorian tree was decorated with candles, candies and fancy cakes that hung from the branches by ribbon and paper chains. Prince Albert had the first such Christmas tree set up at Windsor Castle in 1841.

The German immigrants brought the tradition into wider use in the United States as early as the 17th century. These trees soon became the height of fashion by the 19th century in America. They also became popular in Austria, Switzerland, Poland and Holland. In China and Japan, Christmas trees, introduced by U.S. missionaries in the 19th and 20th centuries, were decorated with intricate paper designs.

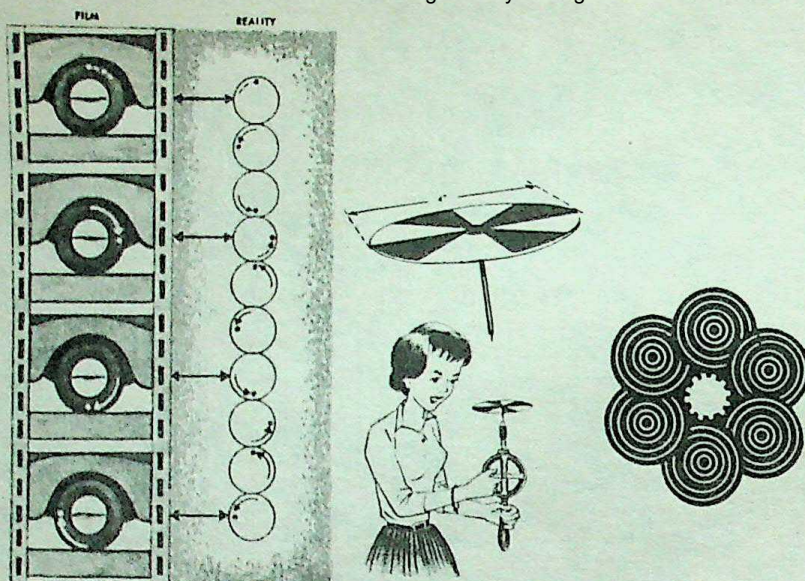


Who were the Incas?

The Incas were South American Indians who ruled an empire that extended from central Chile to the present Colombia-Ecuador border. The Incas established their capital at Cuzco in the 12th century. The first Inca ruler, Manco Capan was believed to have been descended from the sun god. The Incas began their conquest in the early 15th century and within 100 years had gained control of an Andean population of about 12,000,000 people.

The Inca society was a highly stratified one. The emperor ruled with the aid of an aristocratic bureaucracy that was harsh and brutal in the exercise of its authority. Their technology and architecture were highly developed. Most of the Inca people were farmers and grew maize, beans, tomatoes, chillie, peppers, cotton etc. Nobody paid taxes, but every man was periodically called to serve in the army or to aid in the construction of buildings, roads, temples or mining. The Incas built suspension bridges, hillside terraces, long irrigation canals and immense fortresses. Their irrigation systems, palaces, temples and fortifications can still be seen throughout the Andes. In addition to all these medicine and surgery were also highly developed. They made their clothes from the llama wool and cotton. Practically every man was a farmer, producing his own food and clothing.

The Incas were conquered by a Spanish adventurer, Francisco Pizarro in 1532. Pizarro entered the Inca empire with 180 soldiers. At that time a contest was going on between Huascar and his half-brother Atahualpa over who would be the Inca ruler. Atahualpa was winning the contest. Pizarro captured him by treachery. In the meantime Huascar had been captured and killed. Pizarro then killed Atahualpa. Now the Inca Empire had no leader, and it could not resist the brutal Spanish adventurers. He performed this unique feat by capturing and eventually killing the Inca king, Atahualpa. The Spanish conquerors transformed the Inca Empire into a colonial appendage of Spain. The requirements of the colonial economy, with its emphasis on silver mining, led to redistribution of the population into newly established large urban centres. Many Indians migrated eastward to escape the mines and colonial system. The Inca religious institutions were crushed by massive campaigns against the idolatry. According to many historians the civilization the Spanish destroyed was in many ways better than their own.



Why do forward moving wheels sometimes appear turning backwards?

You might have seen in a movie or on a television that the wheels of speeding automobiles sometimes appear turning backwards. Do you know what makes the forward-moving wheels appear going backwards?

To understand this strange optical effect, you have to understand the basic underlying principle of the motion picture. The film projected on the screen consists of a series of individual pictures. The pictures are joined together in such a manner that you can see them one after another in a rapid succession. But there is a very small time, a fraction of a second, between each frame of picture when the screen is completely dark. Usually 32 pictures are shown per second on the screen, and they appear continuous because the impression of an image lasts for $1/16$ th of a second on the retina of our eye.

So in this case each individual picture shows the automobile moving along the road. However, if the wheel does not make a complete turn from one still picture to the next, it appears, as if, the wheel is moving backwards. For example, if we watch the top edge of the wheel in one picture, and if the edge does not make a complete turn, but instead completes three-fourths of a turn, it looks as if the wheel turned one-fourth backward. Now in the third picture, with the wheel making only three-fourths of a turn, the top edge visible in the first picture is directly at the bottom. Again it appears, as if, the wheel has turned one-fourth backwards. Thus the automobile continues moving forward and wheels continue to appear to be going backwards. This is called the stroboscopic effect.

The stroboscopic effect can be demonstrated with the help of the above diagram consisting of six concentric circles with the white gear in the middle. Hold the illustration at about arms length away from you and concentrate on the circles. Hold one hand still and with the other shift the book up and down vertically, about two or three inches in each direction. Notice that the inside of the circles appears to be turning. The gear inside the group of circles appears to be turning in the opposite direction of the circles. This is the same effect as we see when watching a car or train on the movie screen.



What are pesticides?

Any plant or animal that occurs in such abundance as to pose a distinct threat to man or his interests, is called a pest. And the chemicals used for mitigation, control or elimination of such plants or animals are known as pesticides. Today we have algacides, defoliants, desiccants, herbicides, plant growth regulators and fungicides in use to control the growth of undesirable plants which compete with crops or other useful plants. Attractants, insecticides, miticides or acaricides, molluscicides, nematocides, repellants and rodenticides are used to reduce parasitism and disease-transmitting organisms in animals, crops, plants, foods, textiles and human beings.

Most of the pesticides are chemical compounds and act in similar fashion i.e. by blocking some metabolic process. They, however, differ in composition, potency, mode of action, speed of effect. So different pesticides are used at different stages of infection.

Some of the common insecticides are lead arsenate, calcium arsenate which are basically stomach poisons. They act as poisons when ingested. Fluorine compounds such as sodium fluoride and cryolite are also used to kill insects. Chlorinated hydrocarbons like DDT, BHC, lindane, aldrin, endrin etc. are again toxic for insects. Organophosphates are currently the largest and most versatile class of insecticides. Carbamates are a relatively new group of insecticides that include some compounds such as carbaryl, methomyl and carbofuran. Fumigants such as hydrogen cyanide, nicotine etc., kill the pest by acting on its respiratory system.

Insecticides can also kill mites. So they are used as miticides. Some compounds such as acaricide and kelthane are made to be used specifically against mites.

Repellents repulse animals rather than kill them. They are mainly used against mosquitoes, blood-sucking flies and chiggers. Some of the common repellents are dimethyl pthalate and DEET.

For instance some of the pesticides act indirectly on the pests. Chemosterilants inhibit reproduction of insect pests rather than killing them directly. The commonly used chemoster-

ilants are apholate, TEPA, metepa, aminopterin, amethopterin etc. They induce sterilization in insects.

Fungicides are used to eliminate undesirable fungus growth. Some of the commonly used fungicides include lime sulphur, bordeaux mixture, copper sulphate, mercuric chloride, cadmium chloride, phenyl mercuric acetate, ferbam, thiram, folpet, dichloran etc.

Herbicides can be divided into two categories: nonselective, which kill all the undesirable plants and selective which kill only certain group of plants. Some of the common ones include sodium arsenite cacodylic acid dalapon, atazine, barban etc.

Rodenticides are mainly used against vertebrate pests. The most toxic rodenticides are thallium sulphate, arsenic trioxide, arsenic sulphide, strychnine, coumafene, sodium fluoroacetate etc.

The pesticides are usually formulated as liquids or solids. If liquid they are dissolved in water or petroleum oil. The solid ones are in powder form. Most of the pesticides are sprayed by hydraulic sprayers. They can even be used as fog or smoke, or sprayed with the help of hand-operated sprayers in the houses.

No doubt the pesticides are highly useful for us but their accumulation in the environment can pose a serious threat to the welfare of man and wildlife.

Scientists have even developed biological methods for pest control. In biological control a pest is kept under control by its natural enemies. A well-known example is the use of pet cat to catch mice in the house.

What was the stone age?

The stone age has been described as that period in the human history when the man learned to make and use stone tools. This was followed by the metal age.

The stone age has been divided into three periods: the Paleolithic or old Stone Age; the Mesolithic or middle Stone Age and the Neolithic or new Stone Age.

The paleolithic or the old Stone Age essentially began with the appearance of the first 'hominids' or man-like forms such as the australopithecines. The paleolithic men were all hunters. Their tools were generally crude and made by flaking. The oldest Paleolithic tools are about 2,500,000 years old. It is likely that apart from the stone tools, the earliest hominids also used tools fabricated from wood and bone. The Pleistocene Epoch began about 2,500,000 years ago and lasted until about 10,000 years ago. During the latter part of the old Stone Age people had learned the art of making paintings on the cave walls. They had also learned the sculpture work.

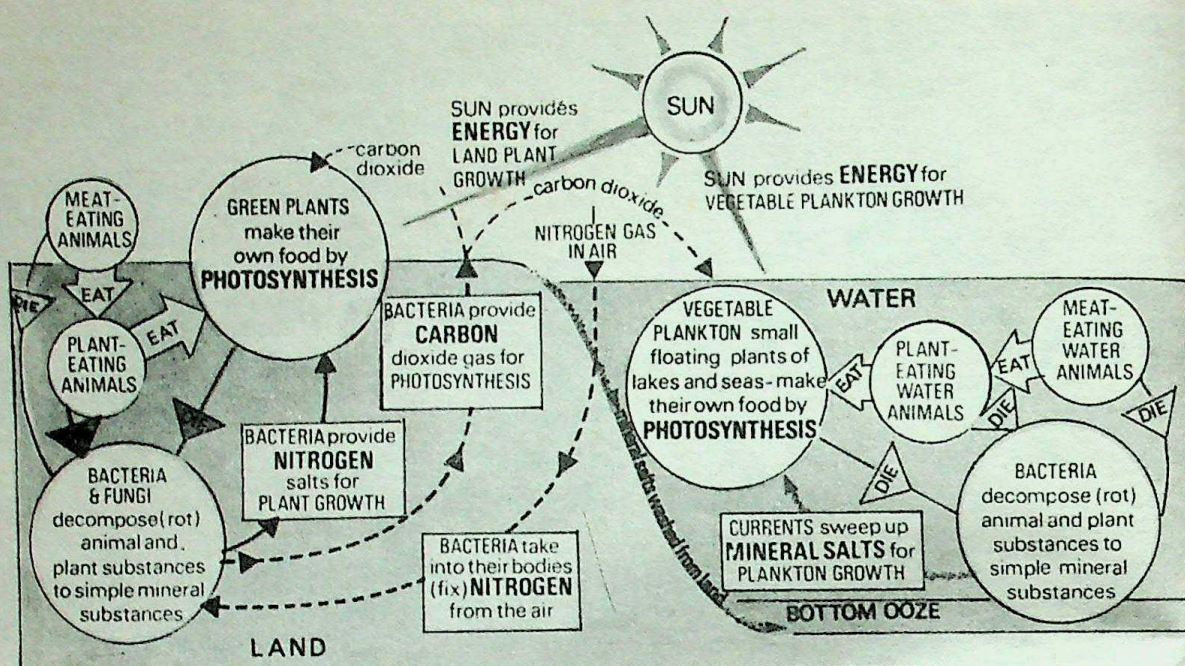
The Mesolithic period or the middle Stone Age usually refers to that period when in the northwestern Europe certain advancement start 8000 BC and lasted until about 2700 BC.



During this period finer stone tools were made. It saw the first use of the bow and arrow for hunting. In Mesolithic period, people had developed a variety of bone antler and wooden tools.

During the Neolithic or new Stone Age, farming and the manufacture of pottery became widespread in Europe. The Neolithic people learned how to grind and polish stone to make tools and weapons. The animal domestication was an important factor in Neolithic life as was agriculture, including the plant care and growing of crops. This was the period when mining also came to be practised. By this time the agriculture had started and the people started forming villages. The Neolithic sense was more the process of natural evolution than revolution.

When the Europeans discovered America most of the native Americans (Red Indians) were living in a Neolithic State. In the 1700s, the aborigines of Australia and Tasmania were at a Paleolithic stage of development. In the Philippines, a primitive tribe is still leading a Stone Age existence even today.

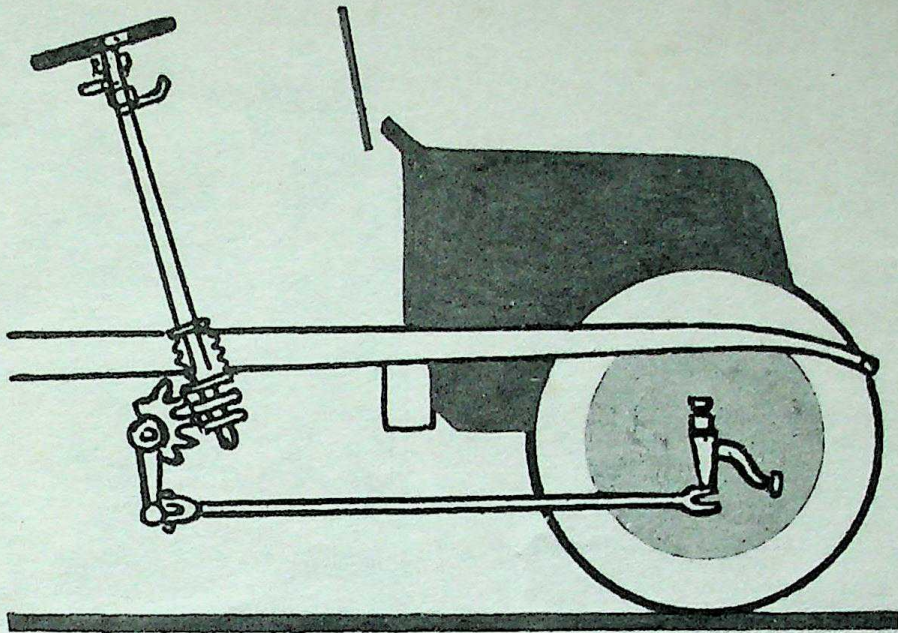


What is the food chain?

The 'food chain' is defined as the sequence of energy transfer from organism to organism in the form of food. The plants, which convert solar energy to food by photosynthesis, are the primary food source. In a simple food chain, a plant-eating animal is eaten by a larger animal. Each of the links in the chain is called a trophic level. The chains do not normally extend beyond four or five trophic levels. A common example of the food chain is grass-cow-human. An example of an ocean food-chain is: plankton-snail-small fish-large fish-shark. In a parasite chain, a smaller organism consumes part of a larger host, and may itself be parasitized by even smaller organisms.

All the food chains begin with a plant, because it is the primary source of food. There are many food chains in an eco-system. Many of the chains are inter-connected so that they are called a food web. Although human beings are able to eat different types of food, there are some animals that feed and survive only on one kind of food. If that one thing is eliminated, the animals will die. This will break the food chain and may cause many environmental problems.

In a food chain, the energy is lost in the form of heat at each step or trophic level. Therefore by cutting out one step, the energy gains will increase. In the over-populated areas, people commonly increase the total food supply by cutting out one step in the food chain. Instead of consuming animals that eat cereal grains, the people themselves consume the grains. Because the food chain is made shorter, the total amount of energy available to the final consumers is increased.



How does a steering wheel make a car turn?

Every automobile—car, bus or a truck—is fitted with a steering wheel. The purpose of this steering wheel is to turn the automobile in the desired direction. In fact the driver uses the steering wheel to guide the automobile. Do you know how the steering wheel turns an automobile?

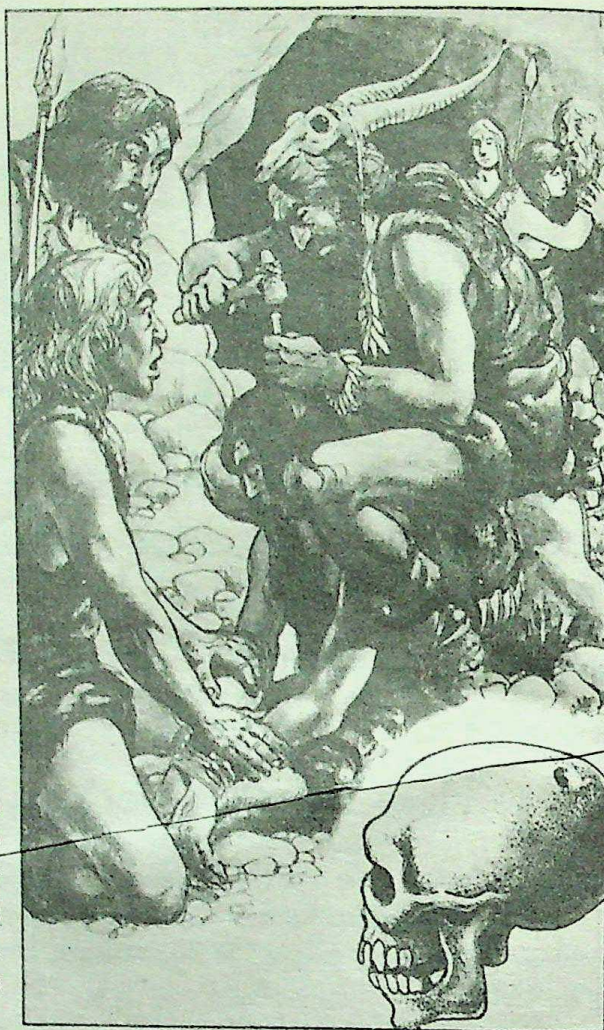
The steering wheel is connected to a long metal bar. It extends into a metal gear box in the front of the car. When one turns the steering wheel, the bar turns the gear. In many cars the gear is a 'worm gear'. This worm gear turns another gear which is connected to a lever. The lever is connected to two rods. One rod is attached to the left front wheel, and the other to the right front wheel. So when the steering wheel is turned, the gear moves the lever. The rods attached to the lever make the car's front wheels turn left or right (see figure above). This type of steering has a disadvantage: it needs higher steering ratios.

To make steering easy for the driver, without using higher steering ratios, power steering devices were introduced in the early 1930s. Most of the modern power steering systems consist of hydraulic boosts applied to either the steering linkage or the steering gear. Rotation of the steering wheel activates a valve that directs oil, pressurized by a pump driven by the engine, to act on a piston. The hydraulic boost acts only while the steering wheel is moving.

What is the black magic of witch doctors?

The witch doctor, in primitive societies, was one presumed to be having mystical power to detect witches, and to combat their evil actions. These doctors acted as physicians, magicians and priests. The primitive people believed that everything on the earth was controlled by supernatural agencies and the witch doctors were supposed to exert influence over them. Even today witch doctors are found in certain primitive societies.

The witch doctor was considered to be an important community member in the tribe. He was able to predict weather, spot out a thief or a killer. He could treat illness by his magical powers and communicate with the dead. People had faith in them just as they have in superstition without any scientific basis.



The witch doctor was armed with black magic. He used it to frighten people with his power and make them follow his wishes. If he wished he could bring a curse on others, could make the crops fail, cause children to fall ill, or make men die. He used a variety of methods to cause a man's death. Sometimes he made a small figure of the man and stuck pins in it or wound rope around it. And sometimes he would get some man's hair or nail cuttings and bury them. As they decayed the man died a slow death.

Often the witch doctor also used herbs and plants in curing illness and water for curing infection. Sometimes he would sprinkle a magic stone with water. He chanted magical songs, prayers and danced in a weird fashion to impress people. He would dress up in bright colour hypnotised people to make them believe that he was mainly responsible for their good luck.

However, one thing one must keep in mind is that these are not established facts, and just 'stories' spread about them over the ages.

When was
the Big Ben built?

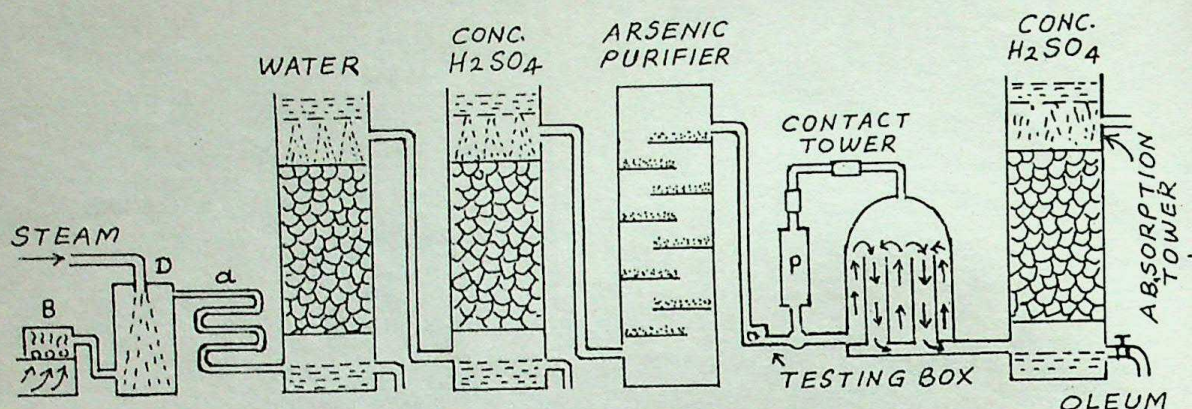


Big Ben is the tower clock famous for its accuracy and a 13-ton bell. It was designed by Edmund Beckett (1st baron of Grimthorpe). It is housed in the clock tower at the eastern end of the British Parliament, Westminster, London. It is called thus because Sir Benjamin Hall, the Chief Commissioner of Works, was the minister responsible for its installation. Originally the name applied only to the bell, but eventually came to indicate the clock itself. It had its first tick on 31st May 1859. It had the longest stoppage for 13 days from noon 4 April to noon 17 April 1977.

The famous deep, resonant boom of the bell is regularly broadcast by the B.B.C. all over the world.

The way leading up to Big Ben is up a spiral staircase of 374 steps. The Roman numerals on the clock face are two feet high and the pendulum is 13 ft long. When the clock was installed, two men used to wind it every week. Now it is electrically wound.

One of the most significant features of this clock has been its great accuracy ever since it was installed.



How is sulphuric acid manufactured?

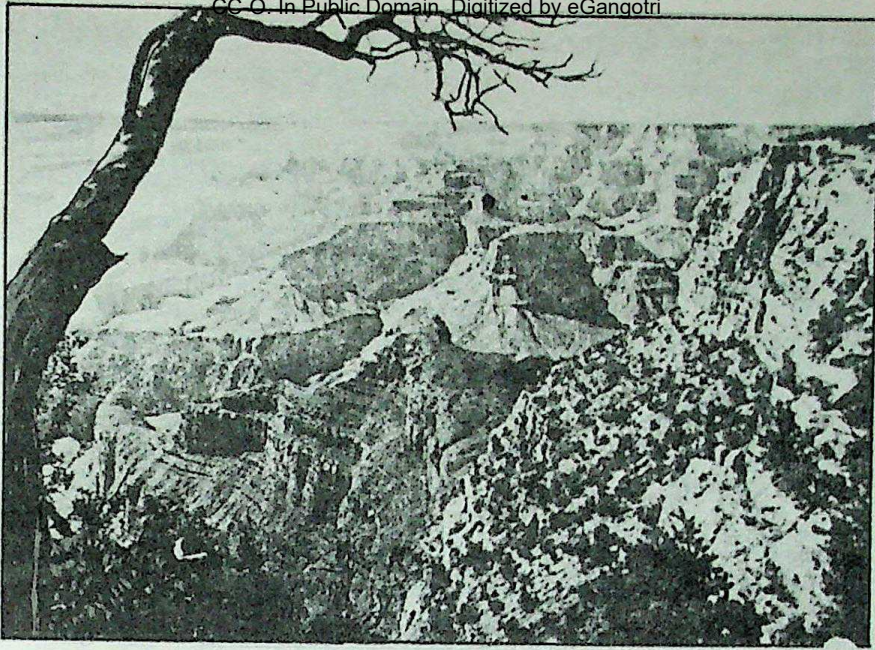
The sulphuric acid is a very important industrial chemical. It is called the king of acids. It is used in the manufacture of fertilizers, dyes, drugs, explosives, paints, synthetic fibres and detergents. It is also used in the manufacture of other acids such as hydrochloric acid and nitric acid. Different metals are pickled in sulphuric acid to clean them. It is also used in refining sugar and petroleum and to produce a vast range of chemicals. Do you know how this acid is manufactured?

These are two methods used to manufacture sulphuric acid. One is known as Lead Chamber Process which dates back to about 200 years. The other is known as Contact Process. The former is less efficient than the later, still it is of considerable commercial importance. Lead Chamber Process is quite a complex one. In theory in it sulphur dioxide is obtained by burning sulphur or roasting pyrites. The sulphur dioxide obtained thus is oxidised by oxides of Nitrogen to sulphur trioxide which reacts to steam to produce sulphuric acid which used as an industrial chemical.

In the Contact Process the sulphur dioxide gas is mixed with air and heated with a catalyst. The catalyst is either the metal platinum or a compound called vanadium pentoxide. The catalyst helps to quicken the reaction. The sulphur dioxide combines with the oxygen in the air to form the compound sulphur trioxide. When sulphur trioxide is dissolved in water, it forms sulphuric acid.

Pure sulphuric acid is a heavy, oily, colourless liquid. It is very reactive and attacks most of the metals to form salts called sulphates. It quickly absorbs water and is often used as a drying agent.

While handling sulphuric acid, one should add sulphuric acid to water and not vice versa. If water is added to sulphuric acid, the heat produced causes drops of water to boil. This makes the hot acid "spit" dangerously.



How was the Grand Canyon formed?

The Grand Canyon in Arizona is a natural wonder of the world. It is famous around the world for its colourful rocks and majestic spectacle. At certain points, it appears like a magic city of rock, with temples, towers and castles of dazzling colours all around. Do you know how this great wonder came to be formed?

The Grand Canyon was formed by erosion of the Colorado River Valley. The waters of Colorado River cut out this great gorge in the course of many thousand years. When we consider the fact that it **was** cut off solid rock in many places, we can imagine the tremendous force of these **waters**. Even now, year by year, the rushing Colorado continues to cut deeper into the bottom of the gorge.

The Grand Canyon is about 347.2 kilometres long and ranges from 6.4 to 46.4 km in width. At places, it is more than 1.6 km in depth.

For years, the Colorado river has slowly cut through the high plateaus of northern Arizona, exposing strata that are millions of years old. These strata are of great interest to geologists because they offer a peep into a long stretch of earth's history. At the bottom of the Canyon, where the Colorado river flows, is an ancient precambrian rock that contains fossils of primitive algae. The fossils of dinosaurs, elephants, trees and other past life are found in the higher strata. The most recent rocks occur near or at the top of the Canyon. The chains of links of its fossils provide an illustration of the evolutionary process.

Each year, more than 1½ million tourists visit the Grand Canyon to wonder at the marvel. In 1919, the United States Government created the Grand Canyon National Park, thus preserving the wealth of plant and animal life that has adapted to this unique environment.

The geologists claim that a few million years ago it didn't exist, and predict that within another few million years, this stupendous cleft on the earth's surface would have completely changed its physical characteristics.

Why is Egypt called the Gift of the Nile?



The Nile, the longest river of Africa and of the world, gives life to Egypt and Sudan. It is 6648 kms long and runs from the mountains of Tanganyike to the Mediterranean sea through Africa.

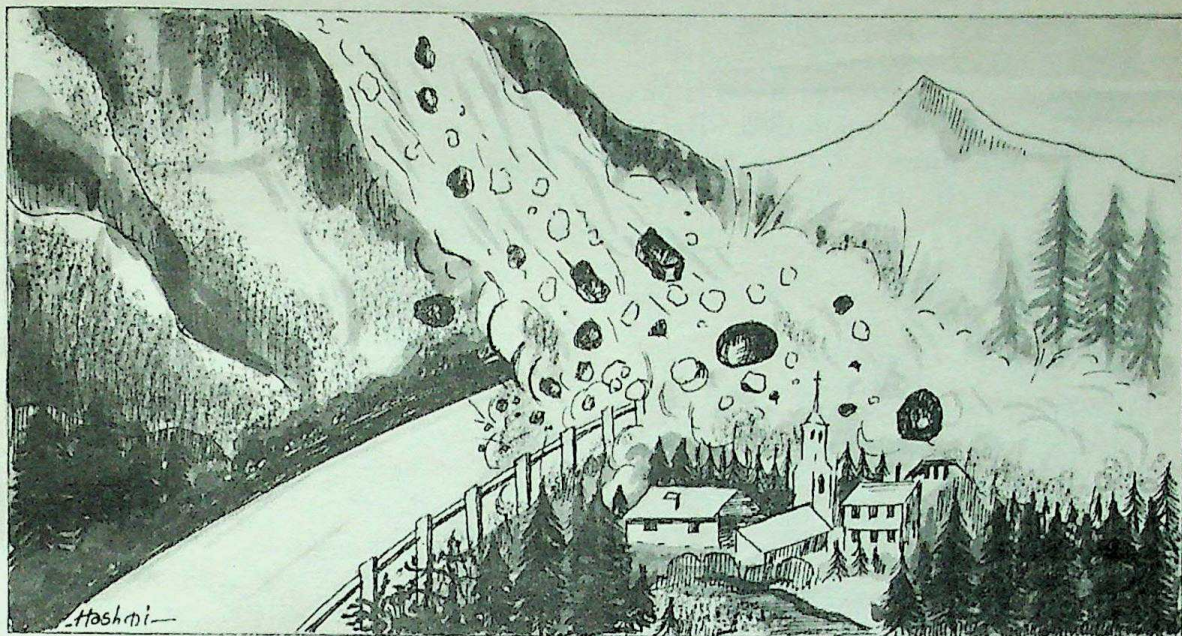
Egypt has been called the gift of the Nile since its valley is extremely fertile mainly because of the yearly Nile floods. It was this fertility that made its ancient people prosperous and helped them survive calamities. Their ancient religion was based on the Nile, and the lives of the ancient Egyptians centred around the river.

The headwater lakes, Victoria, Albert and Edward, are in tropical country, south of the equator. Most of the rain there falls during the winter months. The great lakes hold this water and feed it into the Nile gradually during the entire year.

The floods are caused by the Blue Nile and the Atbara rivers which carry the summer rains of the Ethiopian mountains downwards with such a force that mud and vegetable matter (humus) are washed down along with them. The humus and mud are distributed by the flood waters along the banks of the lower Nile. So the land there, which would otherwise be desert, remains a green oasis.

The immense importance of the Nile for Egypt is obvious from the fact that 95% of its population lives along its banks on less than one-thirtieth of Egypt's land.

The true source of the Nile is in the mountains of the Congo whence the Kagera flows to lake Victoria. The river Sebat and others flow into the Nile and increase its volume considerably. From this point onwards it is called the White Nile. The Blue Nile is the longest tributary of the Nile and has its source in Ethiopia like Lake Tana. At Khartoum the Blue and White Nile come together. There are six unnavigable cataracts between here and the sea. In Sudan the cataracts are used to produce an enormous quantity of electricity. They are circumnavigated by waterways. The Nile has two very big dams built on it. The dams and the cataracts supply a large part of Egypt's electric power.



What is an avalanche?

An avalanche is a large mass of rock debris, snow, ice or soil that moves rapidly down a mountain slope, sweeping and grinding everything on its path. It takes place when a mass of material overcomes the frictional resistance of the sloping surface. It can be caused by spring rains, dry warm winds, or violent vibrations produced by artillery fire, thunder, man-made blasts or earthquakes.

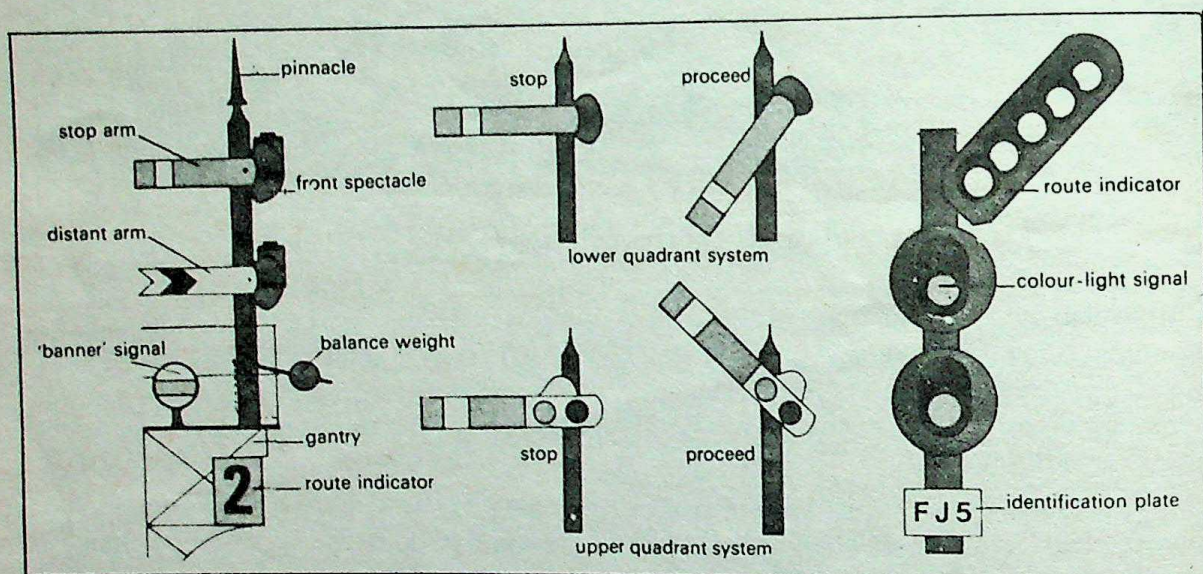
There have been instances where large work avalanches have blocked rivers and buried towns. They are commonly composed of bed-rock fragments, a few centimetres thick in diameter and include lot of soil and dust. The rock avalanches are thought to ride on a cushion of compressed air that allows them to travel long distance. A debris avalanche usually occurs in unconsolidated earth materials when weakened by moisture.

Some snow avalanches occur during heavy snow storms. Sometimes they slide while the snow is still falling, but more often they occur after the snow has accumulated at a given site. One of the causes of snow avalanches is the slow formation of hexagonal cup-like ice crystals under the snow pack. The formation of these crystals creates a zone of weakness near the ground. These crystals act as a lubricant when the upper layers of the snow start sliding down the mountain.

The wet avalanche is the most dangerous thing because of its massive weight, heavy texture and tendency to solidify as soon as it stops moving. The dry type is also equally dangerous because its entraining of great amounts of air makes it act like a fluid.

Since the avalanches present considerable danger to the mountain climbers, skiers, and travellers they are being a subject of lot of research and study. Switzerland has pioneered devices for testing areas for avalanches at the Snow and Avalanche Research Institute. In the United States, avalanche danger is monitored by the Forest Service of the Department of Agriculture.

The greatest avalanches occur in the Himalayas, but no estimates of their volume have been published so far. However, it was estimated that 3,500,000 cubic metres of snow fell in an avalanche in the Italian Alps in 1885. (The largest avalanche in North America took place in the Cascade Mountains of Canada in 1965.) It is called the Hope Slide. 127,092,000 metric tons of rock and mud fell 1200 m to cover part of the British Columbian Highway. It buried three moving cars. The Hope Slide was as wide as 3 km and as deep as 90 m.

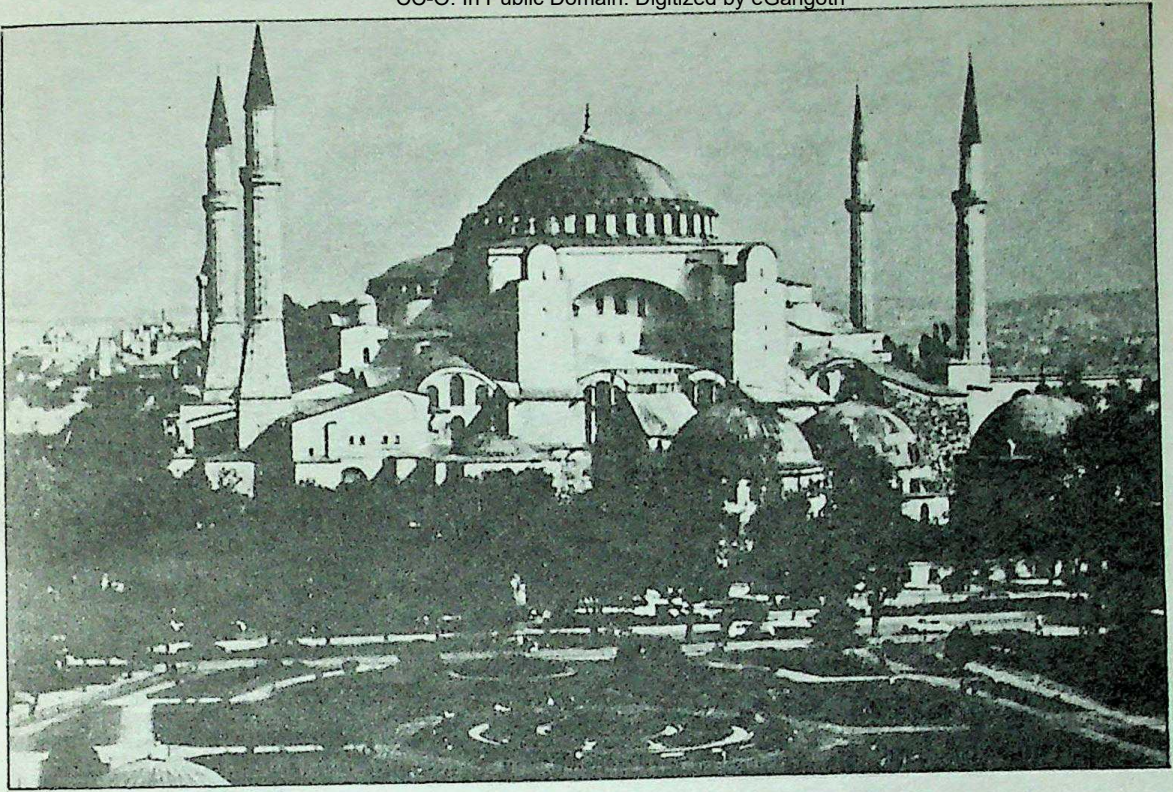


What is a Semaphore?

Semaphore is a device used for signalling or conveying information by changing the position of a flag or light etc. Before the invention of the telegraph, it was used for signalling from high towers, and to transmit messages between distant points. The first such system was developed by Claude Chappe in France in 1794, employing a set of arms that pivoted on a post. The arms were mounted on towers built 8 to 16 kms apart. The messages were read with the help of telescopes.

The modern semaphores include movable arms or rows of lights simulating arms, displayed from towers and used to signal railroad trains.

The semaphore signalling system is still in use at sea between the ships. This involves human arms holding a small flag in each hand. When the messages are sent by human arms, the sender usually moves the flags in his hands at different angles to indicate letters of the alphabet as shown in figure above.

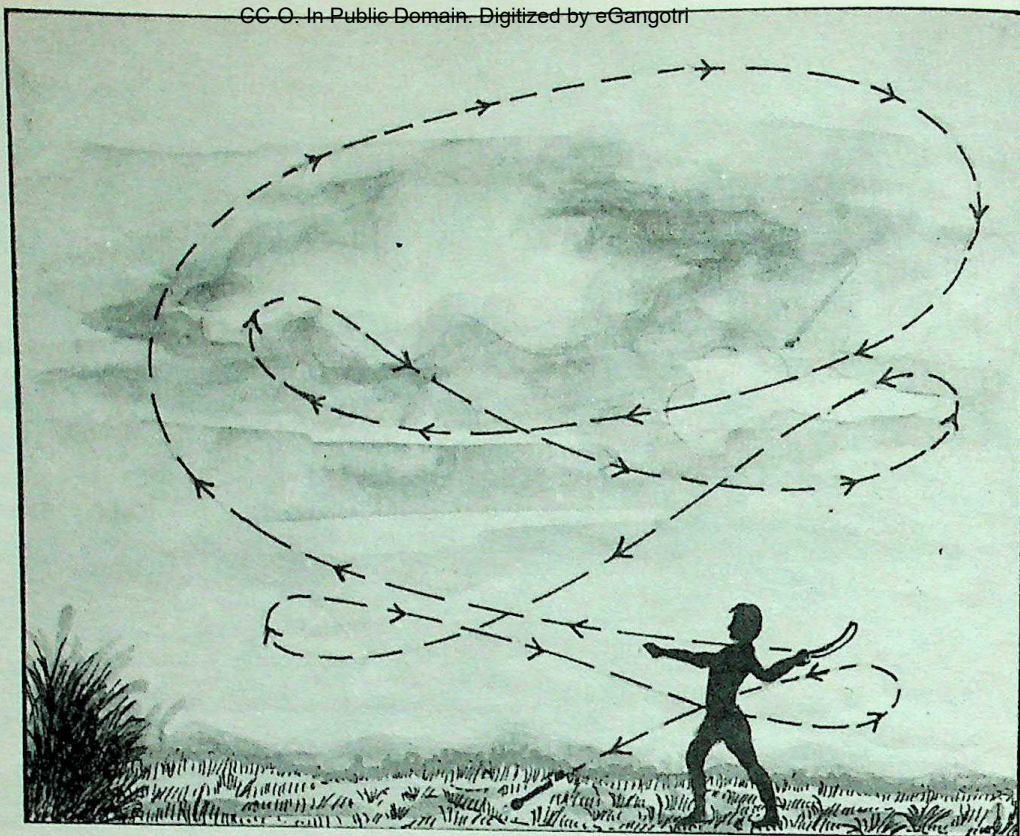


Which city lies partly in Europe and partly in Asia?

Istanbul, the largest city and seaport of Turkey, and one of the oldest in the world, lies partly in Europe and partly in Asia. It stands mainly on the European side of the Bosphorus, the narrow strait which divides Europe from Asia. It has suburbs on the Asiatic side and so controls the only entrance to the Black Sea. The main part stands on a triangular promontory, washed on the north by the famous water stretch called the Golden Horn. Like Rome, it is built on seven hills.

Istanbul's history is marked by great upheavals. In the ancient times, it was called Byzantium. But when the Roman Emperor Constantine made it the capital of his Eastern or Byzantine Empire in A.D. 330 it became Constantinople. Ever since then, until it was overrun by the Turks in 1453, Constantinople preserved the Greek and Roman culture which was being destroyed by the barbaric invasions in the other part of the western Europe. It thus formed a link between the ancient and modern civilisations.

Because of its geographical position, Istanbul is highly prone to earthquakes. However, despite many earthquakes over the centuries, much of it still stands. One of the most famous Byzantine buildings is the great church of St. Sophia, rebuilt by the Emperor Justinian I between 527 and 565 on the site of an earlier church of Constantine. After the Turkish invasion it became a mosque, and in 1935 a museum.



What is a Boomerang?

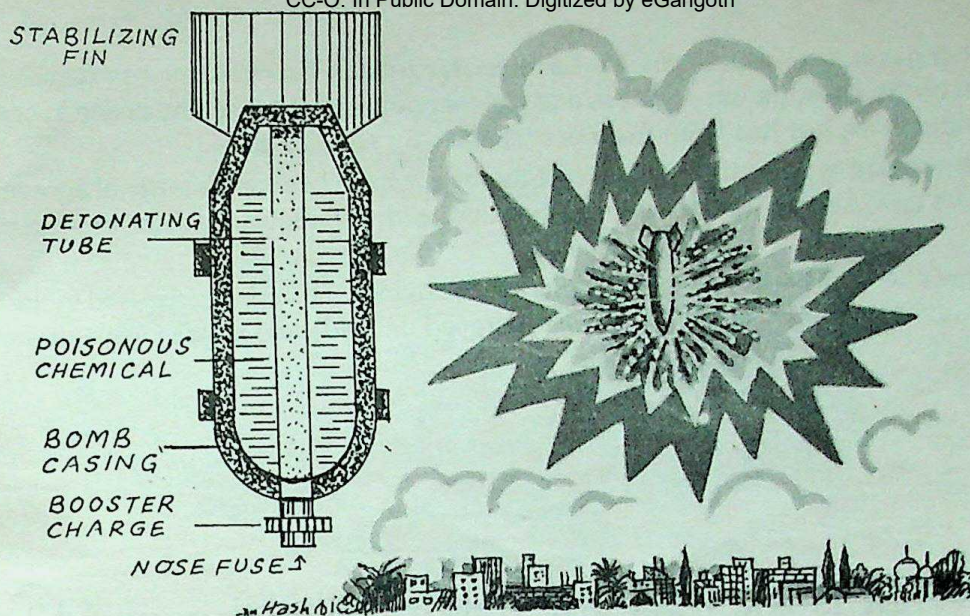
The boomerang is a curved stick of hard wood used for hunting and warfare in Australia and elsewhere. The most noted form is the returning boomerang developed by tribes of eastern and western Australia. It is shaped in such a way that when it misses the target, it returns to the hunter. Its length is about 30-75 cms. (12-30 inches) and weighs upto 340 gms. It varies in form: ranging from deep, even curve to one whose arms are at 90° with the ends twisted in opposite directions. When thrown with power and skill, it completes a circle, 45 metres wide or more and then several small circles upto five, before it drops to the ground near the thrower. Do you know how it comes back to the hunter?

One time the people believed that it was the air, pressing down on its lower flat surface and passing over the upper rounded face, that caused its return. But one T.L. Mitchell, a Scottish explorer of Australia, gave the true explanation to this effect.

First, the boomerang is held from one end, above and behind the thrower's shoulder, with the concave edge to the front. Then it's swung forward rapidly with the flatside underneath. Just before it is released, it is given extra power with a strong wrist movement.

If thrown downward or parallel to the ground, it sweeps upward to a height of 45 metres or more. When thrown in such a manner that its one end strikes the ground it ricochets into the air at a terrific speed, spinning endwise. It completes a circle of 45 metres or wider and then several smaller ones (around five) before it drops to the ground near the thrower.

Non-returnable boomerangs have been used by North American Indians and other hunters against birds and small animals.



What is chemical warfare?

The chemical warfare involves the use of chemical substances to kill or cause physical harm to the enemy, or to destroy its food supply. These weapons usually destroy life without affecting the property.

This type of warfare has been down the ages—in fact throughout the human history. There is evidence to prove that the ancient Greek warriors had developed chemical fire bombs and used them against the enemies. In the recent times, the chemical warfare found an extensive use in the World War I (1914-1918). In January 1915, the Germans used chlorine gas against the Russians in Poland—although to little effect. But on April 22, by the use of similar weapons they scored a tactical victory against the French and British in Flanders that went beyond their expectations. The chlorine affected the lungs of soldiers causing choking and making it difficult for them to breathe. It, in fact disabled so many soldiers that the Germans later devoted much more time for research on harmful gases.

In 1917 the Germans introduced the mustard gas. Its unique property is that it directly affects the skin and is absorbed through it thus rendering the gas masks useless. It causes blisters on the skin and irritation to the lungs. Thus in the war more soldiers died from it than any other gas.

After the World War I, a major breakthrough was achieved by Germany in the development of nerve gases. They were far more toxic than the World War I agents, but were never used. In fact the nerve gases interfere with the normal activity of the nerve cells, and can cause convulsions, vomiting and death. Many such gases are tasteless, odourless and colourless.

Many other such poisonous gases have reportedly been produced in various countries. These also include blood gases which interfere with the normal functioning of the blood and utilization of oxygen by body tissues.

Other gases, such as tear gas, have a temporary effect. Tear gas causes excessive crying, irritation of the nose, mouth and eyes and violent coughing. It is used by police in controlling crowds and riots, but has been used occasionally by military also.

Gas warfare is potentially so harmful that there have been international agreements to prevent its use. And so the gas has not been used with any regularity since the end of World War I.

Some chemicals are used to kill plants. These defoliants were widely used in the Korean and Vietnamese conflicts. Defoliants were sprayed on fields and jungles from airplanes and helicopters.

What is the male : female ratio in the world?

Sex ratio is defined as the proportion of males to females in a particular population and expressed as the number of males for every 100 females. This is also defined as the number of females for per 1000 males in the population.

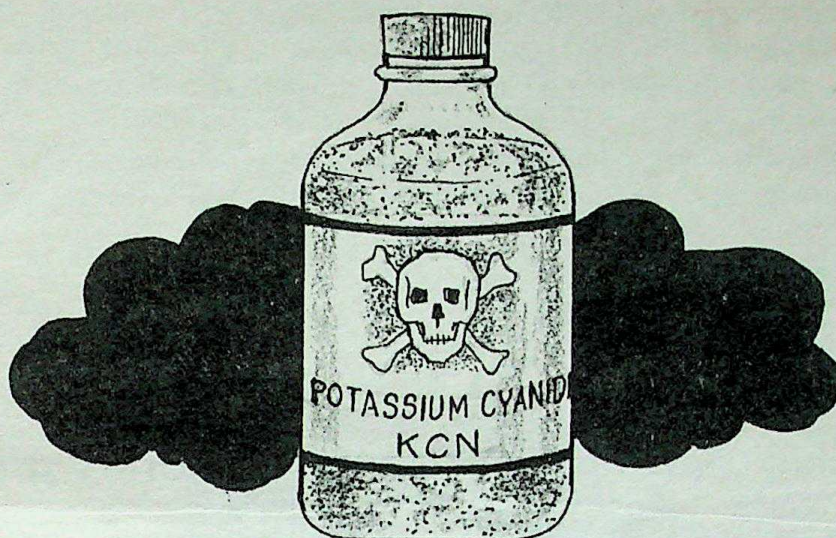
Among the human beings in the world 51 per cent of all births are male. However, in the industrialised western society female survival is slightly better than the males. Thus during adolescence, the sex ratio becomes almost equal and at a later stage (beyond the age of 50 years) the number of females becomes slightly more than men.

The following table shows the sex ratio in India during 1901-1981:

Year	Sex ratio (Number of women per thousand men)
1901	972
1911	964
1921	955
1931	950
1941	945
1951	946
1961	941
1971	930
1981	935

This table shows that as compared to men the number of women in India has been less. Apart from the fact that the sex ratio is adverse to women, it will also be noticed that sex ratio has deteriorated over the decades.

Kerala has the highest sex ratio of 1034 and is an exception. In all the other States and Union Territories, the sex ratio is adverse to women.



What is a poison?

A poison is a toxic substance. When taken in sufficient quantity, it causes irritation, soreness, roughness or redness on the part of the body. It can cause internal injury, sickness or even death.

There are different types of poisons: corrosive, irritant, systematic, gas poisons and food poisons.

The corrosive poisons kill the living tissues. In case of human beings it may damage the lining of the mouth or throat. Sodium hydroxide is an example of a corrosive poison. The acids and phenols are also corrosive poisons.

The irritant poisons cause swelling and soreness of the mucous membranes. They may also damage the stomach, intestines or nerve centres. Some medicines, when taken in sufficient quantities, can act as irritant poisons.

The systematic poisons attack the nervous system and other important organs such as liver and heart. For example small doses of prussic acid or strychnine can kill a person. Many barbiturates such as amobarbital, pentobarbital, phenobarbital etc. taken, in large doses, act as systematic poisons. Of the systematic poisons the boric acid, quinidine, chlorpromazine are very toxic poisons. Some of the other systematic poisons include chloracetophenone and arsenic compounds.

The gas poisons cause difficulty in breathing and may even lead to death. Some gases irritate the eyes, nose or skin. Carbon monoxide is a very poisonous gas. Hydrogen sulphide and some war gases are also quite poisonous.

The food poisoning can result from consuming certain undesirable chemicals or organisms. For example, chemicals such as insecticides can cause food poisoning. Organisms such as hemlock and certain shellfish can also cause food poisoning. Some fungi such as toadstools and berries are again undesirable food substances. Also stale meat or fish can become poisonous.

There are some strong poisons which are extremely potent. For example, dioxin used as a weed killer is a deadly poison. Potassium cyanide is a very strong poison. Cyanide blocks the basic energy providing mechanism in most cells and causes death almost instantaneously. Some other supertoxic poisons include atropine, heroin, and nicotine.

Every poison is different in its basic character. So in case of a suspected poisoning its best to call a physician without losing any time. He would only know how to treat a particular case.

Why is Shakespeare regarded as the world's greatest poet and playwright?

William Shakespeare, English poet and dramatist is widely regarded as the greatest writer of all time. It is believed that Shakespeare wrote 34 plays between 1591 and 1614. His first play is believed to have been 'Henry VI', and his last two probably 'The Tempest' and 'Henry VIII'. His plays are today performed more often and in more countries than ever before. Ben Jonson's (another of his great contemporaries) prophecy that he 'was not of an age but for all time' has been marvellously fulfilled.

Shakespeare's early life was spent in Stratford-on-Avon, where he attended the local grammar school. At the age of 18, he married a local girl, Anne Hathaway, who bore him a daughter, Susanna and twins, Hamnet and Judith. By 1584 he had emerged as a rising playwright in London. He continued to live there, enjoying fame and prosperity as a member of London's leading theatre company, the Lord Chamberlain's Company (afterwards known as the Kings Men). They played at the Globe Theatre, Bankside which was burned down in June 1613, during a performance of Henry VIII.

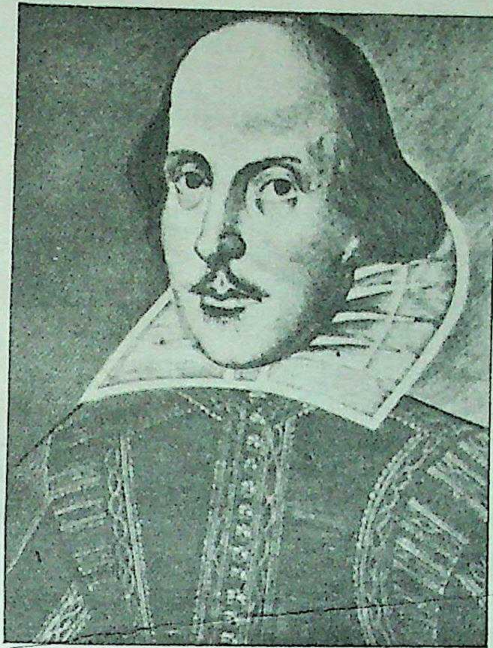
In about 1610 Shakespeare retired to his birthplace and lived as a country gentleman. His will was made in March 1616, a few months before his death. He was buried in the parish Church at Stratford.

Despite the fact that we know a lot about Shakespeare's life and works, it is not known with certainty when Shakespeare's plays were written or first produced. The available evidence suggests that the dates of first performances, as given below, are based on the assumption that he ordinarily wrote two plays a year. The first collected edition of Shakespeare's plays known as the 'First Folio' was published in 1623.

According to the available evidence the chronology of Shakespeare's works is as follows:

Comedies :

The Comedy of Errors (1592/93); The Taming of the Shrew (1593/94); The Two Gentlemen of Verona (1593/95); Love's Labour's Lost (1594/95); Midsummer Night's Dream (1595/96); The Merchant of Venice (1596/97); Much Ado About Nothing (1598/99); As you Like it (1599/1600); The Merry Wives of Windsor (1600/01); Twelfth Night (1601/1602); Troilus



and Gressida (1601/1602); All's Well That Ends Well (1602/03); Cymbeline (1609/1610); The Winter's Tale (1610/11); The Tempest (1611/12); The Two Noble Kinsmen (1612/13).

Tragedies :

Titus Andronicus (1593/94); Romeo and Juliet (1594/95); Julius Caesar (1599/1600); Hamlet (1600/01); Othello (1604/05); King Lear (1605/06); Macbeth (1605/06); Antony and Cleopatra (1606/07); Coriolanus (1607/08); Timon of Athens (1607/08).

Historical Tragedies :

(1) Henry VI (1589/92), (2) Henry VI (1589/92), (3) Henry VI (1589/92), (4) Richard III (1592/93), (5) Richard II (1595/96), (6) King John (1596/97).

Histories :

1. Henry IV (1597/98), Henry IV (1597/98) Part II, Henry V (1598/99), Henry VIII (1612/13).

Poetry :

Shakespeare's sonnets were published in 1609. The dates of writing are not known. The 154 sonnets refer cryptically to various persons—particularly a handsome young man, a dark woman and a rival poet whose identity, if they were real, remains the object of speculation.

Shakespeare wrote two heroic narrative poems 'Venus and Adonis' (1593) and 'The Rape of Lucrece' (1594). His 67-line elegy, 'The Phoenix and The Turtle' was published in Robert Chester's 'Loves Martyr' (1601).

Why do you get “pins and needles”?

“Pins and Needles” is the tingling sensation you feel in your hands, feet, arms or legs when the blood begins to circulate in those areas after being impeded. For example when you sit with your leg curled up in one position for a long time and then try to stand up, you sometimes feel that your leg has “fallen asleep”. As the blood begins to flow again, the familiar tingling sensation will occur. Do you know why do you get this tingling sensation?

We know that blood flows freely through the blood vessels in our body, just as water flows freely through a stretched hose. Imagine what would happen if you bent the hose! Water would only trickle through.

As the blood runs through blood vessels, one of its most important functions is to pick up the poisonous wastes from various organs. When a recession occurs in the flow these poisonous wastes accumulate and block the nerve cells from carrying messages from the foot to the brain. When the leg is stretched, the blood starts flowing again and causes the tingling sensation.

What is solar wind?

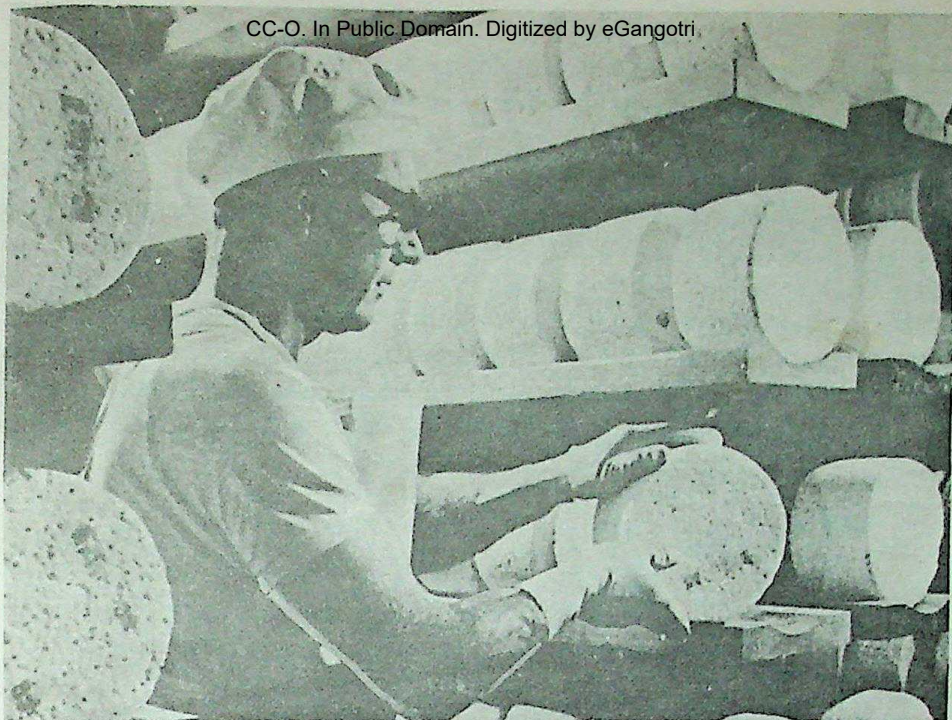
The solar wind is the constant flow of charged particles from the sun. These particles include protons, electrons and some nuclei of heavy elements. They are accelerated by high temperatures of the solar corona or outer region of the sun, to velocities high enough to allow them to escape from the sun's gravitational field.

The solar wind streams from the sun through outer space at speeds of about 480 km (300 miles) per second. It takes the particles about $3\frac{1}{2}$ days to reach the earth.

The scientists are still in the dark about the precise source of the solar wind. However, what they are certain about is that the solar wind is much stronger during periods of sunspot activity.

The solar wind causes the tails of comets to change direction and point away from the sun. It also causes magnetic storms which may disrupt radio communications on the earth. The solar wind causes ionization of the gases in the upper atmosphere, resulting in the coloured light phenomena known as an aurora.

When the solar wind encounters the earth's magnetic field, a shock wave results, the nature of which is not fully understood. That part of the solar wind which does not interact with the earth or the other planets, continues to travel at supersonic speeds upto a distance of approximately 20 astronomical units (one astronomical unit = about 1.5×10^8 kms). And there as it passes through a similar shock phenomenon it loses this supersonic characteristics. Here the gas cools off and eventually diffuses into galactic space.



How is cheese made?

Today there are a number of cheese varieties made from the milk of different animals such as cows, goats, sheep, buffalo, mare, llama and yak. All these varieties can be divided roughly into two groups: 'hard' and 'soft'.

Hard cheese, such as cheddar, is made from pasteurized whole milk ripened with a culture of lactic acid bacteria, that converts some of the lactose into lactic acid.

The milk proteins are then coagulated into a sort of 'curd' by the addition of rennet. Rennet contains the enzymes, rennin and pepsin obtained from the stomach of young calves. The curd is then cut into cubes to allow the liquid residue (whey) to separate. It is then heated to 38°C to drain off whatever whey might be left. It is then cut into blocks which are pressed to remove the last traces of whey.

These blocks of dry 'curd' are cut into small pieces and then salt is added to act as a preservative and improve its flavour. Finally the cheese is produced by pressing the slated curd in moulds for about 48 hours and then ripening under controlled temperature and humidity for three to six months. The ripening occurs on account of bacterial and enzyme action.

Soft cheese is made in a similar way except one major difference: the whey is left to drain off from the curd by gravity without applying pressure or heat. The resulting cheese has a high moisture content, between 50 and 70 percent, and they have mould cultures that excrete enzymes to give them characteristic flavour.

Lactic acid cheese is produced by the action of lactic acid on the milk protein. The acid coagulates the protein into a soft curd, which is then simply drained off whey and then salted.

Cottage cheese is made in a similar way, but it is made from pasteurized fat-free milk and the curd is washed with skim milk. This often containing skim milk powder to give it its characteristic texture.

The process of making cheese reduces milk to its one-tenth volume. The curd or soft gel, is formed by the chief protein in milk(casein).This occurs when enough lactic acid is developed from lactose by the micro-organism present in the milk, or when it is acted upon by rennin. At the moment of coagulation, all of milk constituents, including most of the fat, casein and other water insoluble substances, are present in the curd. The cheese manufacture has been of primary economic importance for hundreds of years in many European countries such as the Netherlands, France, Italy and Switzerland. In the modern factories, cheese is mass produced according to standardized recipes and techniques that result in a product of much more uniform quality.

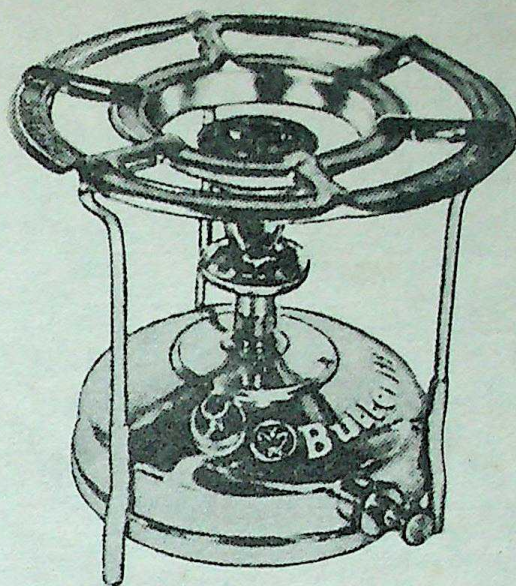
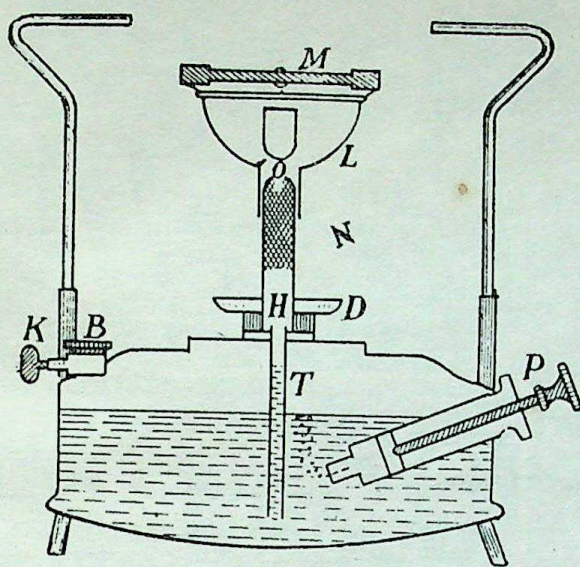
What were the causes of Vietnam War?

The causes of the Vietnam War date back to the times of French domination which was formally recognised at the Convention of Tientsin in May 1885. The name Vietnam came into popular western use in 1946 to designate the eastern part of Indochina that stretched from the borders of China in the north to the delta of the Mekong River in South. The French colonial rule generated a deep discontent among the Vietnamese people and the Indochinese Communist Party, formed by Ho Chi Minh, arose in 1930.

During the Second World War, the Japanese worked with the French to suppress the rebellion. But in 1945 Ho Chi Minh established the Vietnam League to intensify his struggle for Independence. It was generally known as the Viet Minh which after Japan's surrender seized control of Hanoi in the North, and proclaimed Vietnam's independence.

From 1946 to 1954, the French fought to oppose this independence. This made Ho Chi Minh lead a guerrilla warfare against them in the First Indochina War. It ended in a victory for the Vietnamese at Dien Bien Phu on May 7, 1954. An Agreement to this effect was signed at Geneva in an International Conference on July 21, 1954. The treaty provided for a temporary division of the country at the 17th parallel of latitude between a communist dominated north and a U.S. supported south. This conference was held under the co-chairmanship of Britain and Russia, with China and the United States playing pivotal roles.

The activities of pro-communist rebels in South Vietnam led to U.S. intervention and the Second Vietnam War (1965-75). This caused great destruction and loss of life. It came to a brief halt in 1973, when a cease fire agreement was signed on Jan 27 and the U.S. troops were withdrawn. The war was soon resumed. In 1975 the South Vietnamese government collapsed and was replaced on April 20 by a communist regime. In 1976 the two Vietnams were reunited as the Socialist Republic of Vietnam.



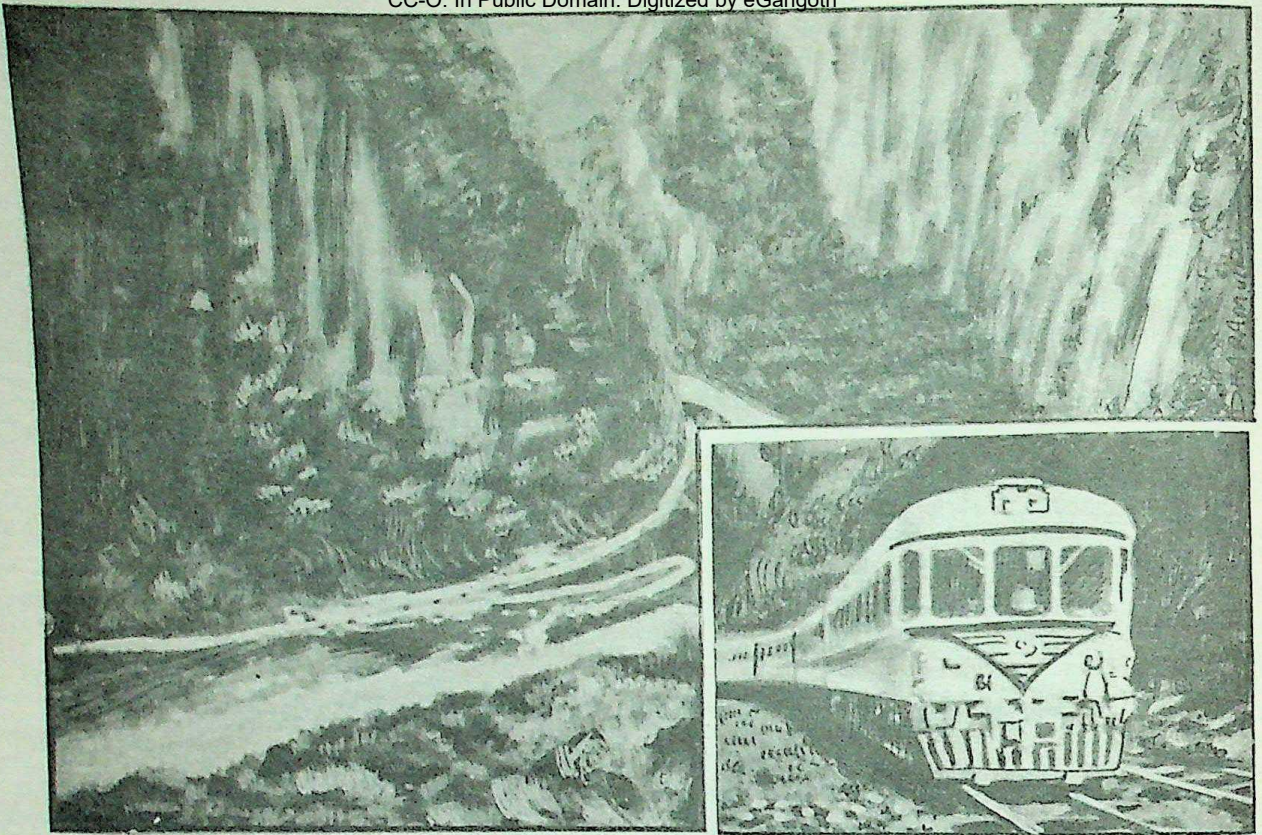
How does a kerosene oil stove work?

The kerosene oil stove is used as a domestic source for cooking. It is a portable heat-producing appliance. It produces heat by burning kerosene oil. Do you know how does an oil stove operate?

A kerosene oil stove has a metal container consisting of a reservoir of kerosene oil and is fitted with a hand driven compression pump 'p' and a tube 't'. There is an air-tight key 'k' which operates an air valve that keeps air entrapped inside the reservoir when necessary. Around the hole 'h' is firmly-fixed a vapourising tube 'n' having a small hole at the top. The tube 'n' contains a piece of wire gauze. There is a hole 'b' in the reservoir for it with kerosene oil. At the top a burner 'm' is fitted where the kerosene oil burns and produces flames of fire. There are three rods fitted with the stove's body which serve as a stand. There is a cup shaped structure 'd' which is used initially for warming up the tube 'n' and burner 'm'.

To produce fire, first the kerosene oil or spirit is burned in the cup 'd' so that the tube 'n' and burner become sufficiently hot to vapourise the oil. Then hand driven compression pump is pumped with hand. This causes oil to rise in the tube. As soon as this oil reaches the gauze and burner it gets converted into vapours due to the heat on the gauze and burner. This vapour starts burning and produces the flame of fire. This flame is used for heating the water or cooking the food.

Stoves making use of wicks and kerosene oil have also been developed. In these stove kerosene oil rises along with the wick due to surface tension and produces flame for heating.



Where is the highest railway in the world?

The railroad is one of the most important means of transportation today. Everyday thousands of trains travel along railroad tracks throughout the world. While some carry passengers, others grain, lumber, coal, machinery and many other products. The fastest trains reach a speed of over 200 km/hr. An average freight train can haul thousands of tons of goods across a continent.

Today there are railroads in almost every country on the globe. Do you know where is the highest railway in the world?

The highest railway in the world is in Peru. A branch siding of the track rises to 15,844 feet above the sea-level. But the highest point on the main line is 15688 feet in a tunnel called La Galera.

All the railway lines in Peru belonging to the Central Railway of Peru are of standard gauge (4 feet 8½ inches), like most of the railway tracks in Europe and North America.

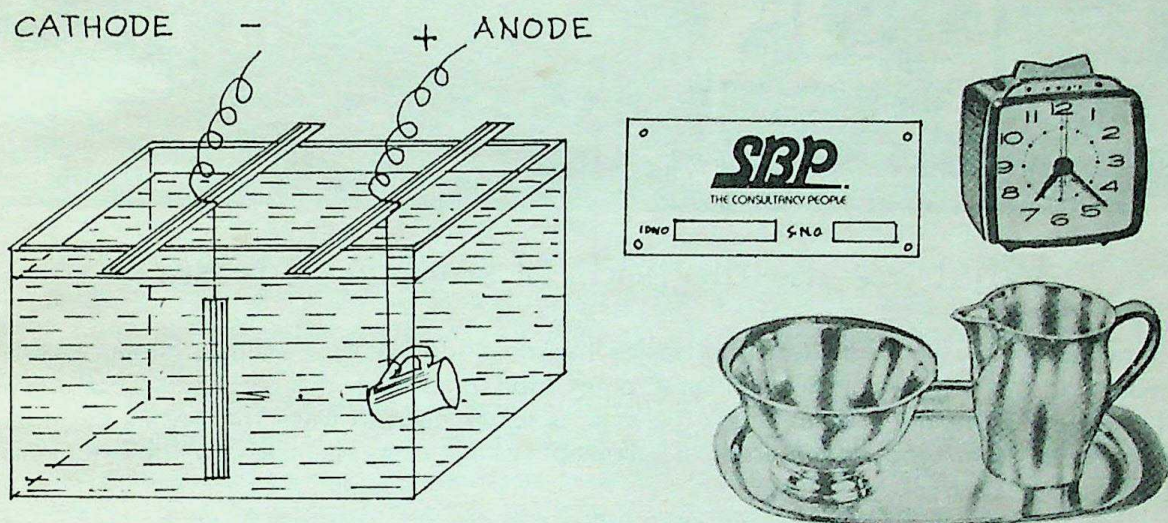
The highest railway station in the world is also in Peru at La Galera. This station is at an altitude of 15,685 feet above the sea-level. This unique railway track has been the feat of an engineer named Henry Deiggs. This was completed nearly a hundred years ago.

The world's longest rail line is in the Soviet Union. It extends upto about 9010 km (5600 miles) and connects Moscow with Vladivostok.

In most of the countries except the U.S.A., the Central Government operates the railroads. In the United States private companies own and operate all the railroads. One of

the Canada's two major railroads is owned by the government. The other one is privately owned.

Japan's passenger trains are the fastest in the world. Many Japanese trains travel at an average speed of more than 160 km/hr. The fastest Japanese trains run on the New Tokaido Line, between Tokyo and Osaka. They make the 515 km long trip in three hours.



How are metals anodized?

Anodizing is a process of coating a metal with a protective oxide film by chemical or electrolytic means. This helps the metals to resist corrosion. In this regard, mainly aluminium or magnesium are anodized. However, metals like beryllium, tantalum, titanium and zinc can also be anodized.

The natural oxide film on aluminium is thin. Anodizing makes a thicker oxide layer. This protects the aluminium from corrosion and makes it last longer.

In anodizing, aluminium is used as the positively charged electrode of an electrolytic cell. Electrolytes such as sulphuric acid or chromic acid are used as a solution. The oxide layer forms from the metal surface outward. This makes the outside layer slightly rough and porous. After anodizing, the pores on the metal are sealed by hot water or steam treatment which causes dehydration and a resulting volume expansion of the oxide. This further prevents corrosive substances from attacking the metal.

Anodizing with sulphuric acid makes a clear oxide film. With chromic acid, a dull film is produced. Even coloured films can be produced by using dyes. Chromic acid is also used for anodizing zinc.

The sewage is a watery mixture of all wastes that come from homes. It includes human wastes soapy and dirty water from sinks and bathrooms, food scraps and other garbage washed down the drains. More than 90 percent of sewage is water used to wash the wastes away. A household might produce hundreds of gallons of sewage every day. Do you know how it is disposed?

There are two ways of disposing the sewage. It can be stored in septic tanks in the ground until it gets soaked into the soil, or it can be dumped into rivers and oceans. The big cities may produce millions of gallons of sewage every day. Since the ground doesn't have enough space for all of it, the cities are forced to dump the wastes into rivers and oceans. Unfortunately, this causes serious pollution.

The sewage may be carried from homes in underground pipes which lead to a sewage treatment plant. Once in the plant, the sewage undergoes primary treatment. It removes the solid wastes by allowing them to sink to the bottom of a large tank. The liquid sewage is drained off the top and the solid sewage is collected from the bottom and burned. Some sewage plants provide for only primary treatment. The liquid sewage is then poured into rivers.

Most modern sewage treatment plants have equipment for a secondary treatment which removes the harmful germs and the floating wastes. The sewage is mixed with those bacteria that breakdown the wastes into harmless products. This process of destroying the waste kills off many germs. Large amounts of chlorine are then mixed into the water to kill all the remaining germs and other micro-organisms.

Today many modern treatment plants have introduced a third step also. It removes the nutrients and chemicals that make water undrinkable. So, when the water passes through a tertiary treatment plant, it gets clean enough and can be drunk.

A problem with many sewage treatment plants today is that of the street sewers. When it rains hard for a long time, the sewer pipes get flooded. To prevent the water from backing up into the streets or breaking the pipes, there is an open section of pipe near the plant. At the time of heavy rains, the water overflows into the river before reaching the plant. Because the sewage is mixed with the sewer water, it pours into the river without being cleaned. This causes pollution. Many modern cities have embarked upon projects to separate the two systems of pipes.

How are different detergents made?

A detergent is an organic chemical substance composed of carbon, oxygen, sulphur and hydrogen compounds. When combined with water it helps to clean soiled materials. The ordinary soap is a type of detergent, but it has a different chemical composition. The household detergents, used mainly for cleaning clothes and utensils, come in powder, flake or liquid form.

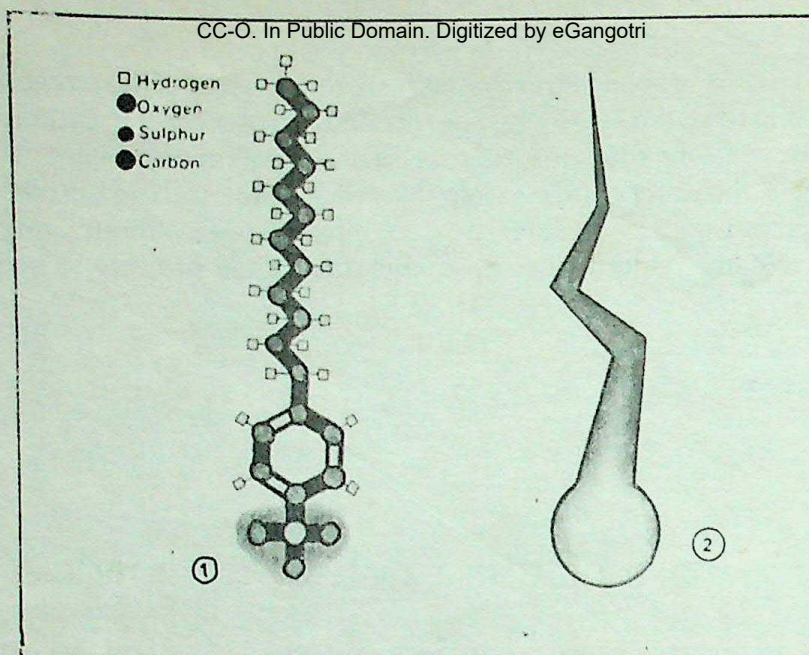
The first detergent was developed in 1916 by a German scientist called Fritz Gunther. In 1933, household detergents were introduced into the United States. During the World War II, since the ingredients for making soap became scarce, detergents came into wide use for the first time. Since then their use has been on the constant increase.

All the detergents contain a basic cleaning agent called a surfactant or surface-active agent. The surfactant molecules attach themselves to dirt particles in soiled materials, like cloth etc. They pry the dirt particles from the cloth and surround the particles with a layer of water that allows them to be carried away. The surfactants, that are made by treating beef fat or tallow with various chemicals, increase the wetting ability of water by lowering its surface tension. The surface tension is the force that keeps water molecules separate and help to move deeper into soiled materials. This helps remove deep-seated dirt particles in fabrics. For example, surfactants also help detergents create lather and suds. Contrary to the popular belief, lather and suds have very little to do with the cleaning ability of a detergent.

Most of the detergents contain many other agents besides surfactants, including bleaches, fabric brighteners, builders and stabilizers. They also contain antiredeposition agents that prevent removed dirt particles from returning to the clean material.

The surfactants can be divided into three main groups: anionic, which become negatively charged ions when in solution; cationic, which form positive ions in solution; and non-ionic which do not become ionized. Detergents may be anionic, cationic or non-ionic or a mixture of two or more type of surfactant.

The most common synthetic surfactants used in domestic detergents are the anionic alkylbenzene sulphonates. These are produced by the sulphonation of an alkylbenzene. The



alkyl benzene is treated with oleum to give the sulphonated alkylbenzene and sulphuric acid. The sulphuric acid is diluted with water and separated from the sulphonate, which is then neutralized with caustic soda.

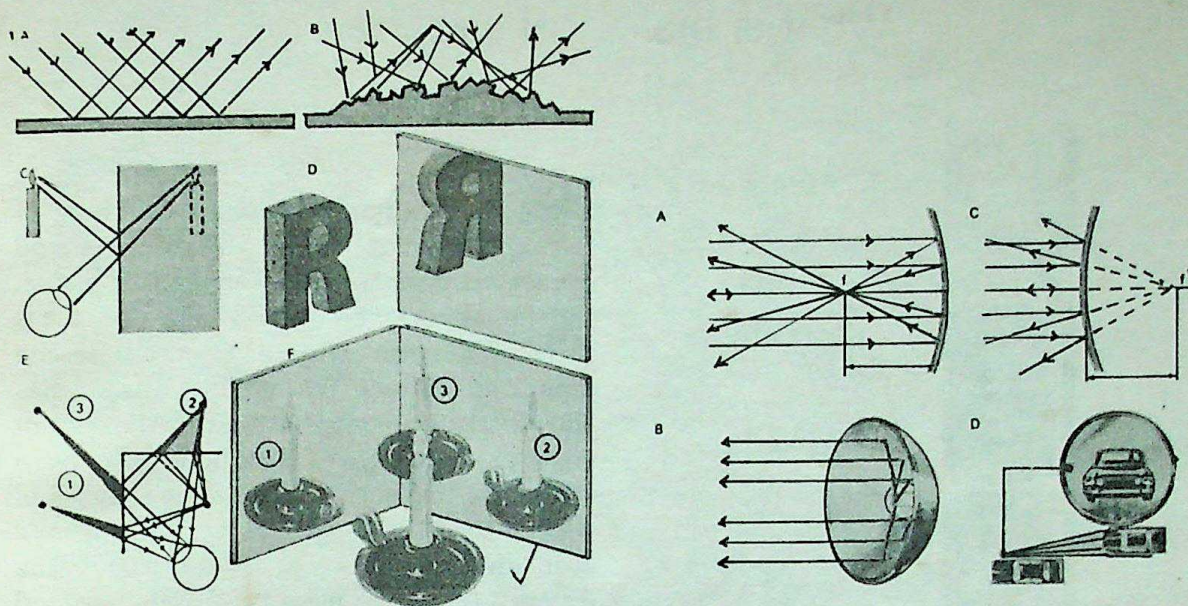
Non-soap detergent powders, which contain 20-25 per cent surfactant are manufactured by spray drying a mixture of surfactant paste and the other ingredients. The liquid detergents are produced by mixing the ingredients in liquid form, together with a hydrotrope such as sodium xylene sulphonate or potassium toluene sulphonate which ensures that the ingredients do not get separated from the mixture. The non-ionic surfactants are the ethoxylated alkylphenols. These are made by heating ethylene oxide and an alkylphenon to a temperature of 180°C in the presence of an alkaline catalyst.

Special detergent formulations are manufactured for a wide range of industrial cleaning purposes.

Which are the different types of mirrors?

A mirror is a piece of polished metal or sheet of glass silvered at the back that produces images by reflection. They are very useful for us. The mirrors are usually made by placing a smooth coating of aluminium or silver on to a glass surface. They obey the laws of reflection. A ray of light strikes the mirror and is reflected into our eyes. Do you know how many types of mirrors are there?

The mirrors can have flat or curved surfaces. A flat mirror is called a plane mirror. The image seen in a plane mirror is called a virtual image. Although we can see it, it cannot be projected onto a screen. This is because the image appears to be formed behind the mirror. The image in a plane mirror is erect but laterally inverted i.e. the right-hand side of an object becomes the left-hand side in the image and vice versa. The image is always of the same size as



the object. The plane mirrors are used in homes for seeing oneself, decorative purposes and in many optical instruments.

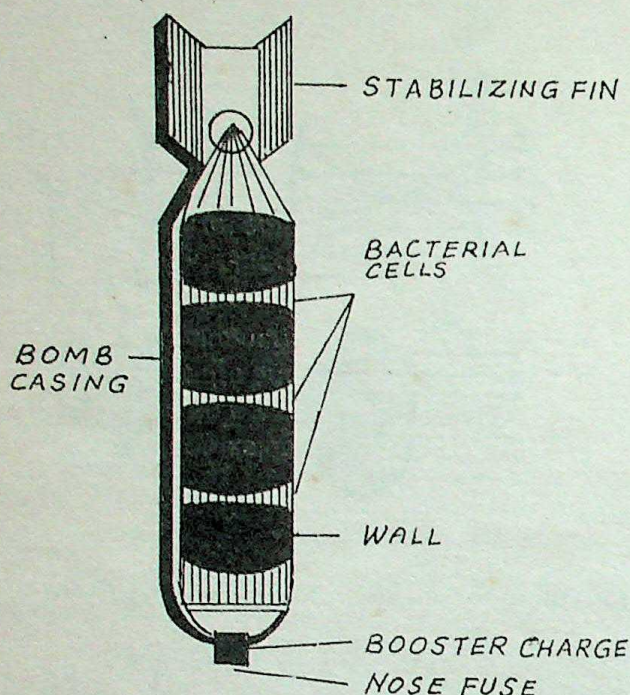
There are two different types of curved mirrors—convex and concave. The convex mirrors curve outwards and concave mirrors inwards. The image in a convex mirror is always smaller than the object. The image is erect and virtual. The convex mirrors are used as rearview mirrors in automobiles. They allow the driver to see a large area of the road behind him.

The image in a concave mirror depends on how far the object is from the mirror. If the object is placed close to the mirror, its image is virtual and magnified. A magnified image is larger than the object. Since they have magnifying properties, the concave mirrors are used as shaving mirrors. If the object is beyond a certain distance from the mirror, the nature of image changes. It becomes smaller (than the object) and upside down. The image now lies in front of the mirror and is said to be real. A real image can be projected onto a screen.

The curved mirrors also have cylindrical, parabolic and ellipsoidal surfaces. The cylindrical mirrors focus a parallel beam of light to a line focus. A parabolic mirror may be used to focus parallel rays to a real focus. These are used in telescopes and search lights. An ellipsoidal mirror will reflect light from one of its two focal points to the other.

The mirrors are produced by coating the glass surfaces with metallic silver. This is done through a chemical process. Sometimes even copper and gold are used for the purpose. Mirrors are also being produced by vacuum deposition of silver or aluminium on glass surfaces. Most of the mirrors are coated with aluminium because as compared to the silver it is inexpensive.

What is biological warfare?

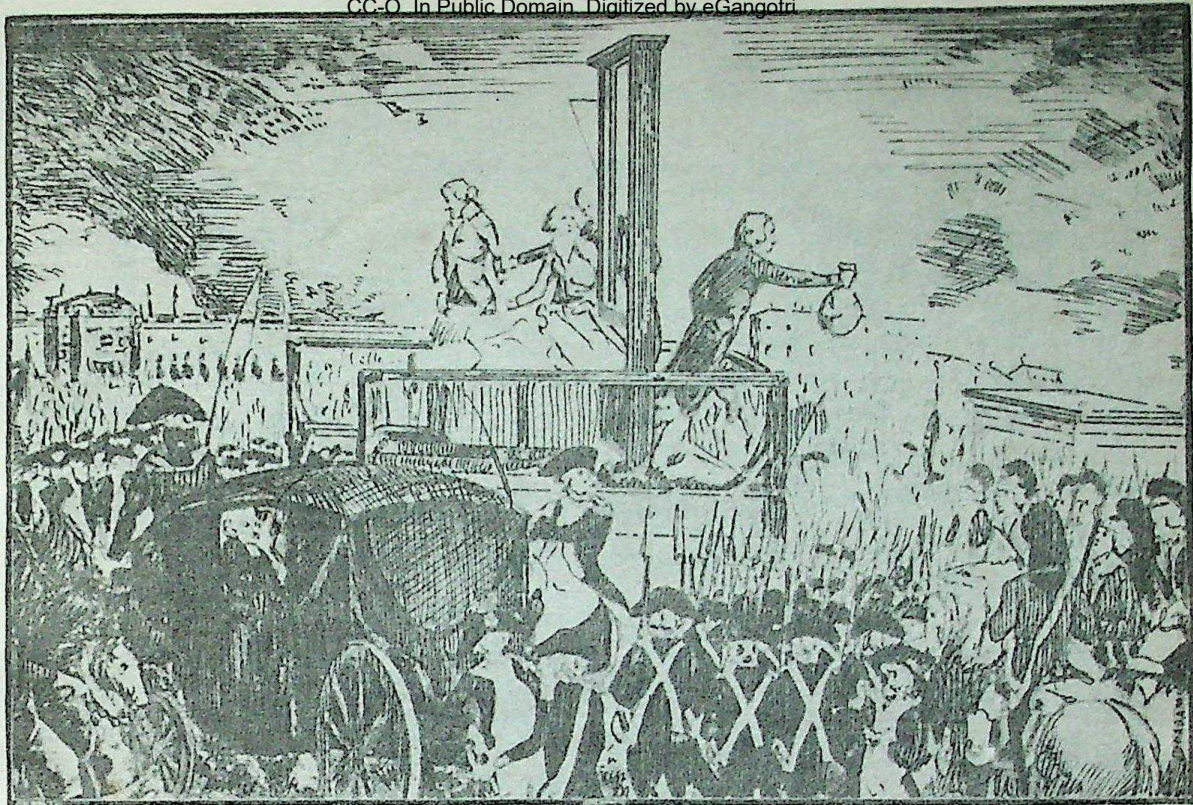


Biological warfare involves the use of disease-producing agents like bacteria and viruses on human beings, animals or plants, and the means for combating such agents. It is also called germ warfare. Contrary to the general impression this type of warfare has been in use for many centuries. In the ancient times, armies used to put the bodies of cholera and plague victims into the water supplies of the enemies. The corpses of such victims were even thrown into the enemy cities. The American Indians were sold germ-afflicted blankets by French traders during the Indo-French wars. These blankets belonged to smallpox victims.

We all know that there are many germs that are highly infectious, resistant to sunlight and heat, and produce instant or long-lasting effects. It would be difficult to prove that a widespread sickness or disease was the result of biological warfare and not of a natural epidemic. Thus it is possible, for a country to launch a biological attack before an armed one without being detected. This could reduce the size of enemy army and lower its morale. In fact a few millilitres of certain micro-organisms could destroy the entire population of the world.

The only effective defence against biological warfare is an active public health service. This agency should be responsible for detection of the disease, immunization, distribution of masks and protective clothing and decontamination of persons already exposed to such germs.

In 1969, the United States announced that it would not use biological warfare, even if other countries did. In 1972, an International treaty was signed by more than 70 nations prohibiting production, stockpiling, or development of biological weapons and requiring destruction of existing stockpiles. The 70 countries that signed the treaty are currently engaged in destroying the stored biological agents.



What was the French Revolution?

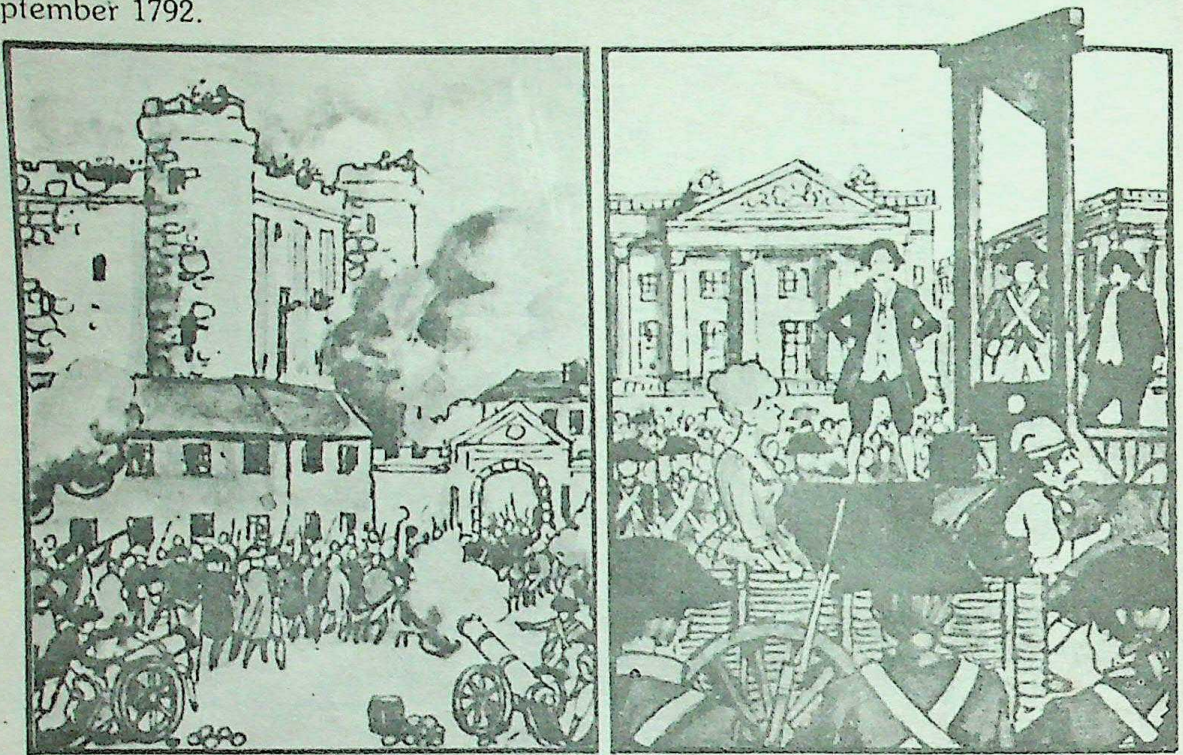
The French Revolution is one of the greatest landmarks in the history of mankind. It ushered in a new era of liberty, equality and fraternity. The revolution started on July 14, 1789 in France with the storming of the Bastille prison in Paris. It was a peoples' revolution that started during the reign of King Louis XVI. It had its roots in masses' deep resentment over the brutal oppression and exploitation by the aristocrats and the ruling classes.

King Louis XVI in 1789 tried to solve his financial problems by calling a meeting of the Estates-General, the French parliament. When this almost forgotten body met on May 5 for the first time in 175 years, the third estate (representatives of people) defied the nobles and clergy and declared themselves as the National Assembly. On June 20, they took an oath not to disperse until they had given France a constitution which would defend the middle class and peasants against the feudal aristocracy.

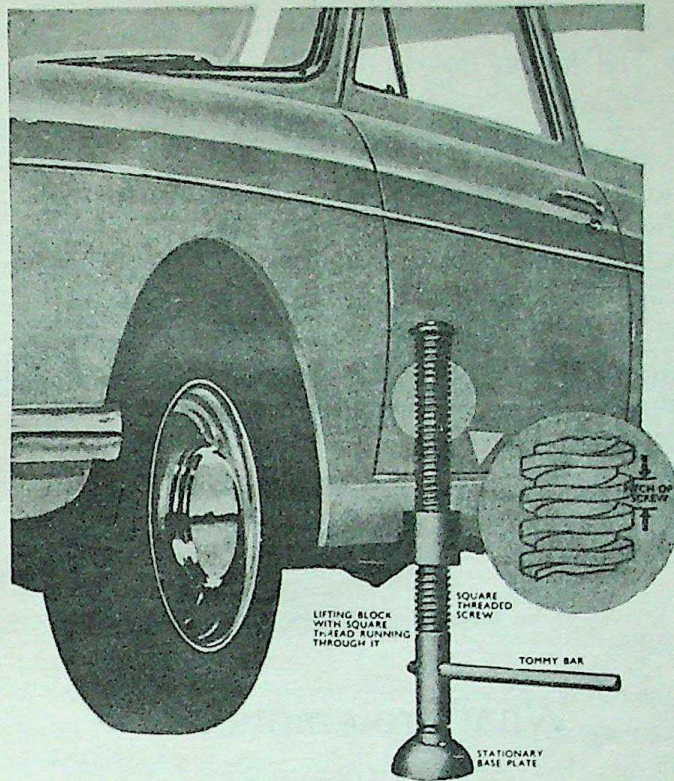
The King then decided to break up the assembly. As the troops were called in, the rumours spread that leading members of the Assembly would soon be arrested. This enraged the people, who began to gather in thousands. They were soon joined by the guards. They surrounded the Bastille, a state prison, on 14 July. After a four hour siege, they broke open the doors, freeing all the prisoners. The fall of the Bastille symbolized the fall of autocracy. This day is still a national holiday in France. This is known as the revolution of France.

After July 14, 1789, Louis XVI was king only in name. The National Assembly began to enact laws. Two years after the fall of the Bastille, the National Assembly issued the

'Declaration of the Rights of Man and Citizen', proclaiming liberty, equality and brotherhood. Then came the flight and recapture of the royal family and the declaration of a republic in September 1792.



Four months after, the king and the queen were tried and executed. This was followed by a declaration of war against Britain, Holland, Spain and Hungary. Then, a radical group, the Jacobins, came to power. Fearing that the revolution was in danger, the group began a bloody, 'Reign of Terror'. In 14 months, some 17,000 people were tried and executed. Many others died in the mass killings. The violence subsided and a new constitution was drawn up. But the army became increasingly powerful and this led to the rise of Napoleon. On November 9, 1799 Napoleon Bonaparte seized power. The revolution was over, leaving Europe and the world a lasting legacy of violence in the cause of liberty and equality.



How does a screw jack work?

Every automobile driver carries a screw jack for raising the axle of his car in event of a tyre being punctured. The screw jack falls in the category of simple machines which, like levers, pulleys and inclined planes, are used for raising large loads with little human effort.

A simple screw jack comprises a rod in which a square screw thread has been cut, a base plate in which this can rotate and a block (or nut) through which the screw thread runs. This block is shaped in such a manner that it hooks on to the underside of the car. When the screw is rotated by means of the thin rod or a tommy bar, which passes through a hole in the screw, the block is slowly raised or lowered.

A screw thread is in fact a spiral cut made in the rod so that the screw may be regarded as a spiral inclined plane. For each complete turn of the screw it advances the same distance. This distance is the pitch of the screw, which can also be found by measuring along the length of the screw the distance between two adjacent ridges of the thread. The screw of a screw jack whose diameter is $\frac{3}{4}$ in. may have six threads to the inch, so the pitch of the thread is $\frac{1}{6}$ inch. Thus, for every one complete revolution of the tommy bar the lifting block moves $\frac{1}{6}$ of an inch up or down.

The velocity ratio of any machine is found by dividing the distance 'e' through which the effort moves by the distance 'l' through which the load is raised. If the tommy bar is a little over

6 in. in length it will trace out a circle of radius of 6 in. for each complete revolution. The circumference of this circle is about 37.7 in. so that the load is raised by $1/6$ in. for every 37.7 in. that the effort moves. The velocity ratio of the screw jack can be calculated thus :

$$\frac{e(\text{effort distance})}{l(\text{load distance})} = \frac{37.7}{1/6} = 226.$$

Even if the thread of the screw is kept clean and well greased, there is still likely to be considerable friction between the screw and both the lifting block and the base plate. Thus a load of 565 lb. (about 5 cwt., which is the weight supported by one of the four wheels of an average family car) could be lifted by a $2\frac{1}{2}$ lb. effort if there were no friction. But in practice the effort would be between $7\frac{1}{2}$ lb. and to 10 lb.

On account of the large frictional forces between the screw and the block, the load cannot 'unscrew' itself and run back under its own weight.

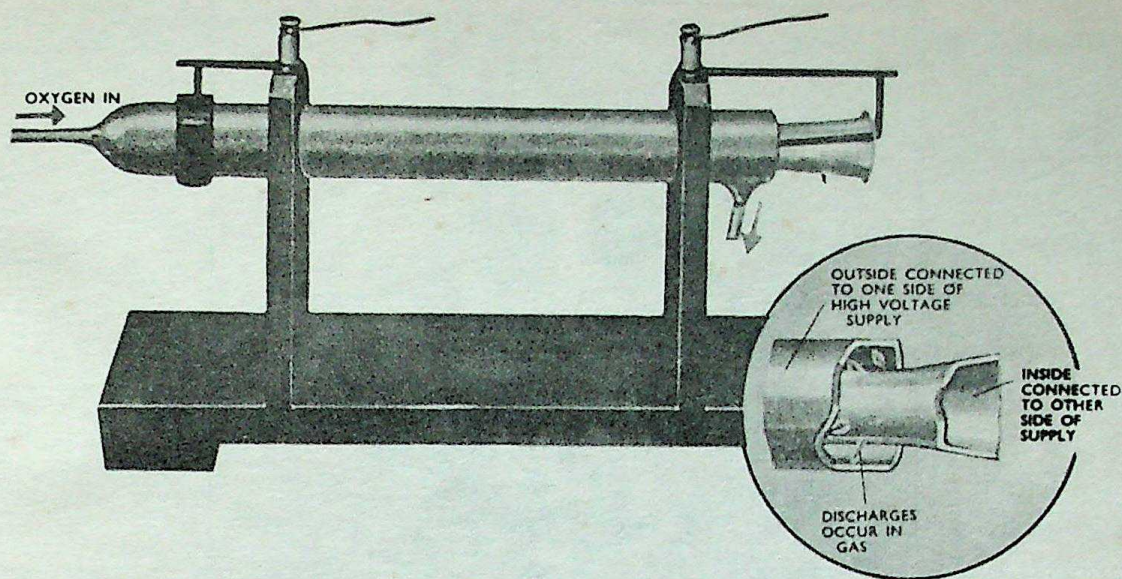
What are emotions?

Emotion can be described as an excited state of mind in reaction to certain thoughts or stimuli. They can be positive as well as negative. The positive emotions are those which make a person happy. Some of the examples of positive emotions are, love, happiness, pleasure and pride. Negative emotions make a man unhappy. Anger, fear, sadness, hate, disappointment and pain are the examples of negative emotions.

Many doctors believe that the new-borns have no emotions at all. They learn them through environment just as they learn to walk and talk. A young child, for example, may not have a fear of a growling dog or a snake unless it bites the child. Then he may develop a fear and avoid it in future.

The emotions cause many chemical changes in the body which is a part of the body's defence mechanism. For example, if a person is in a dangerous situation, his adrenal gland sends a hormone called adrenalin into his blood stream. As the blood travels, the adrenalin makes his heart beat faster, sending more blood to his brain and muscles. At the same time, more sugar enters his blood to give his body extra energy to handle the difficult situation.

The emotional disturbances can cause various physical ailments. These include asthma, stomach ulcers, rheumatoid arthritis (stiffness of the bone joints) and hypertension. The hysteria is also a result of the emotional disturbances. In this disorder, the patient feels paralysis of some body part though the organ is actually not paralysed. The nerves and muscles are capable of working normally but a mental disorder prevents this. The physicians have found out that such disorders require both medical and psychiatric treatment to cure the patient.



What is Ozone Gas?

Ozone is an allotrope of oxygen. This means that although its molecules contain only oxygen atoms, their number and arrangement differ from that of oxygen gas. The oxygen as we know it, has two atoms of oxygen in each molecule. But the ozone, on the other hand has three atoms of oxygen in each molecule. These atoms are arranged in triangular shape.

Ozone is light blue in colour and has a strong odour. It is poisonous in nature, differing considerably from oxygen in its chemical properties. It is found in the atmosphere in very small quantities the highest concentration being at high altitudes where it is formed by the reaction of ultraviolet light on oxygen. Indirectly ozone is very useful for us since it absorbs harmful ultraviolet rays in the sunlight.

To obtain ozone, ordinary oxygen is passed through a tube where it is subjected to silent electrical discharge. The electrodes are covered with insulating materials (glass or mica) so that the discharge currents are kept low, and high voltage pulses are supplied between the electrodes. This method has to be used so that the oxygen acquires the energy it needs to form the ozone but at the same time ozone does not become so hot that the molecules break up into ordinary oxygen.

Ozone is a powerful oxidizing agent. It is used to sterilize water, to purify air, to decolourize foods and act as a bleach. It is also used to prevent bacterial growth in food stores. Its ozonide-forming property is used in several industrial processes in the manufacture of drugs and plasticizing materials.



Why is it said, “an apple a day keeps the doctor away”?

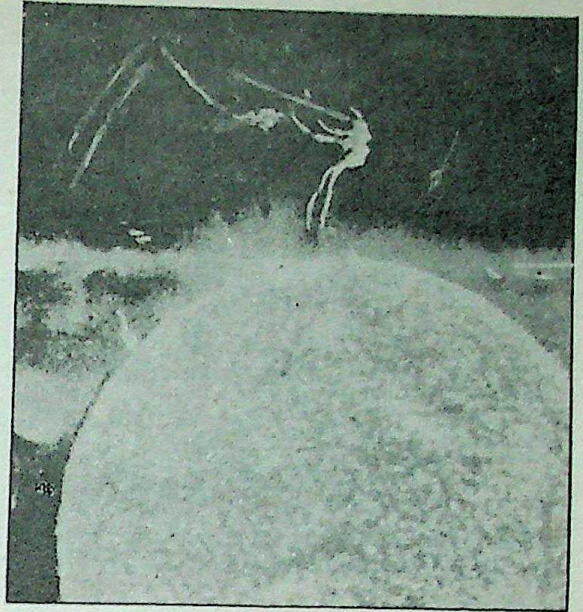
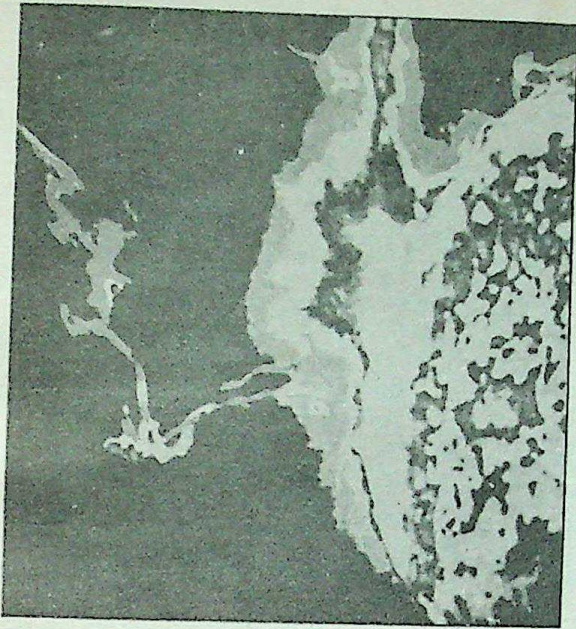
The age-old maxim, “an apple a day keeps the doctor away,” was a polite way of saying that this would help to prevent constipation since it was believed that the juice of a raw apple aided the fermentation of undigested foods.

Although we might query such a sweeping statement in the highly advanced modern times, none can deny that the apples are good for health. Some people have modified this statement and suggested that ‘it keeps the dentist more than the doctor away’. According to the dentists biting on a crisp crumbly apple is an effective way of removing food particles from between the teeth. Eating an apple after meals and cleaning them in the night and morning are the best formula for keeping the teeth healthy.

The apples contain vitamins A and C. They are rich in cellulose and carbohydrates. They also contain some minerals. The presence of these food sources lend some weight to the old adage.

There are 25 species of apple trees belonging to the family Rosaceae. When ripe they are usually red, yellow or green. The apples grow in large quantities in Himachal Pradesh and Kashmir in India. It grows in both the hemispheres. Since the apple trees need some period of relatively cold weather, they cannot be grown in most tropical areas.

The scientists believe that the apple originated thousands of years ago in Turkey as the fruit of a wild roselike shrub. Since then humans developed that wild plant into many kinds of apple trees we know today.



What are solar flares?

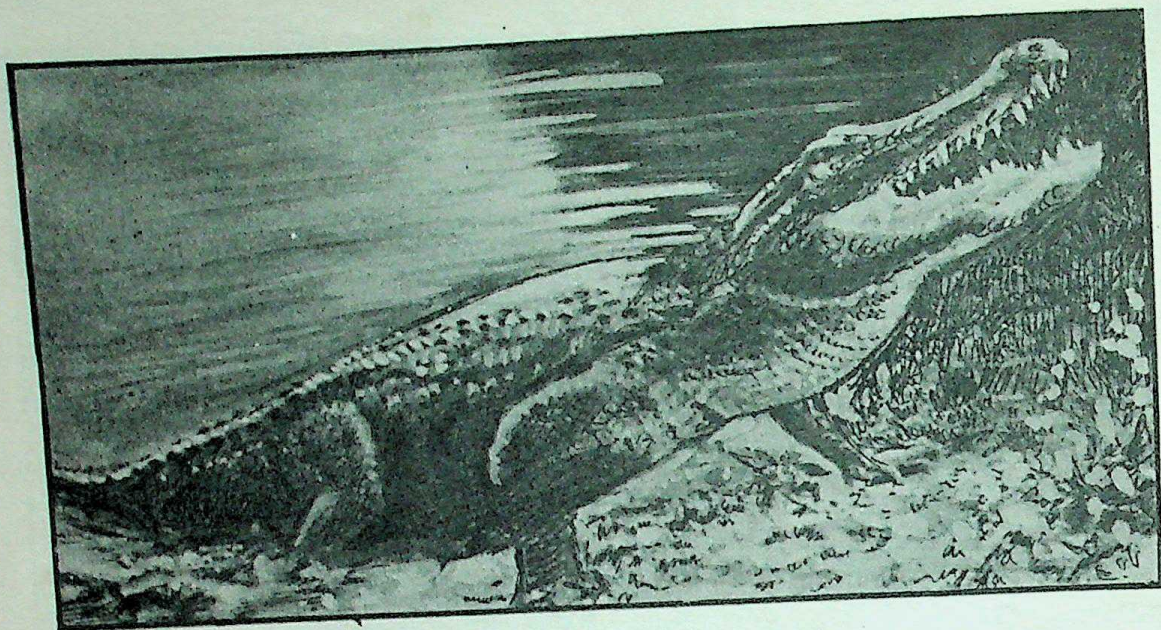
A solar flare is defined as sudden intense brightening of a small part of the sun's chromosphere near a sunspot group. The brightness of the flare may be five times that of the associated plage of facula. The flare develops in a matter of minutes and may last for several hours. In a large solar flare, tremendous energy to the order of 10^{33} ergs is released.

Solar flares occur only as the result of sunspot activity. Practically all sunspots produce some flares but certain spots are much more active. Their source of (flare) energy is the magnetic fields surrounding the sunspots.

Such flares are rarely seen in white light because they are atmospheric phenomenon, with such low density that they're transparent. On the other hand, their temperature is so high that in the ultraviolet region, they may equal the intensity of the entire sun. However, because the flares are most easily observed in H- (H-alpha) and because the H- brightening is an extremely accurate indicator, they can be studied well.

Solar flares emit ultraviolet radiations and X-rays. They also emit great amount of energetic particles and cosmic rays. The particles travel much slower than the light of the flare and reach the vicinity of Earth a day or two later. They pose a potential radiation hazard to human beings in space. The flare radiation and particles, because of their impact on Earth's magnetic field and ionosphere, disrupt radio communications and cause auroras.

Almost every flare is accompanied by the ejection of material. The magnetic field acts like a rifle barrel to collimate the flare energy. Neutral hydrogen is usually ejected in a poorly collimated spray at a speed up to a few hundred kilometres per second. Flares also produce intense streams of electrons. These travel at about one third the speed of light.



Why are crocodiles so dangerous?

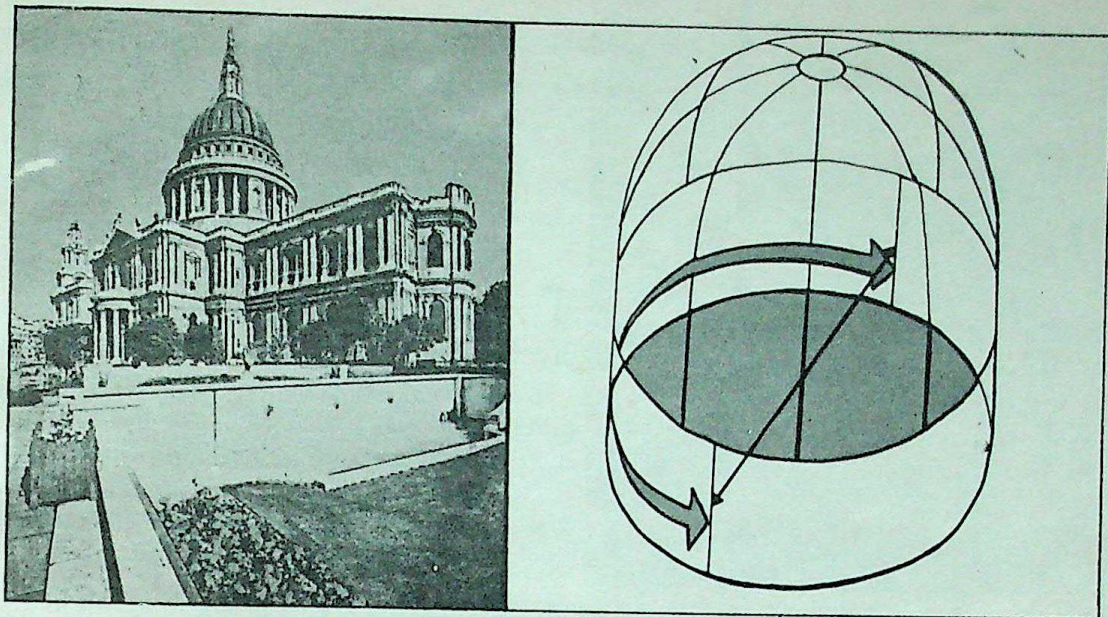
The crocodile is a large reptile with a long cigar-shaped body, short legs and a powerful tail and jaws. Its pointed snout and long, partially exposed sharp teeth help distinguish it from the alligator (another species of the same family). The crocodile is generally more aggressive than the alligator and may attack large animals such as deer or even human beings.

All the crocodiles are carnivorous and feed in water. They are particularly successful in catching smaller animals because they can float closely upto their prey without being seen. Once they catch their prey they slowly tear it apart in bits by gripping with the teeth and turning it over and over again. The crocodiles have been seen mysteriously more aggressive when protecting a nest or when the water is drying up. They usually feed on fish, birds and small mammals.

The crocodiles live in tropical areas throughout the world, usually in swamps or marshes, or along slow-moving rivers. They have webbed feet which help them walk on wet or muddy ground. Since their eyes and nostrils are a little higher than the rest of their heads, they can hide in water staying almost completely submerged, and still able to breathe and watch the movement of their prey.

The female lays several hard-shelled eggs in plant or in sand near the water. She guards the eggs for about four months until they begin to hatch.

Once upon a time there was a large population of crocodiles in the world. One extinct variety measured 15 m (50 ft) long and weighed several tons. At present there are 12 surviving species of the crocodiles. One found in America is about 3.7 m long and lives in the Florida everglades. The Nile crocodile is about 4.5 m long and is found throughout the sprawling continent of Africa. The skin hunters have killed so many of these crocodiles that they are now an endangered species and are protected by law in most of the countries. The crocodiles are valued for their tough hides which are used for making leather handbags and shoes.



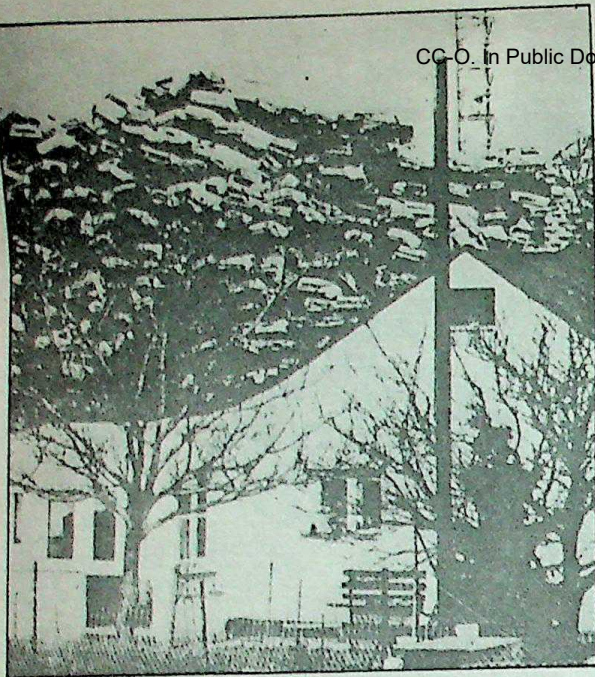
What are whispering galleries?

A whispering gallery is a place where a whisper is audible anywhere or everywhere. Such galleries are made in circular buildings. Their working is based upon successive reflections of sound from its opposite walls. Since there is no loss of energy, the sound of a whisper can be heard at a great distance inside the gallery. For receiving a clear whisper, the ear must be kept close to the wall of the gallery, and it would sound as if, the walls are whispering. Hence this name.

The St. Paul's Cathedral in London has the most famous whispering gallery. It runs around inside its dome. If you speak in this gallery the sound waves of your voice would be carried round to the opposite side of the gallery.

It happens because the waves are successively reflected from the walls, and are prevented from going outwards by the stones lining the circular wall.

The great dome of St. Paul's is in reality two domes—an outer dome with a diameter of 148 feet, and an inner dome whose diameter is 103 feet. The hollow space between the two domes acts as a whispering gallery. There is a whispering gallery in Lucknow. Many visitors come to see it.



Where does all the garbage go?

The garbage disposal has been an age-old civic problem, and has increased with the growing population. Unlike sewage, it cannot be pumped along the drains. In the country districts the garbage is often taken outside a small town or village, and then dumped at some unused land or a disused quarry. The waste paper etc. is set alight.

Sometimes the garbage is even used to fill the low-lying areas. It is spread out in even layers with the help of heavy machines, pressed down and covered with a layer of soil. This process is repeated until a thick garbage and soil sandwich has been made. It is then covered with a fine layer of soil and left to rot. Small organisms in the soil help to decompose the rubbish. The land can later be used for farming.

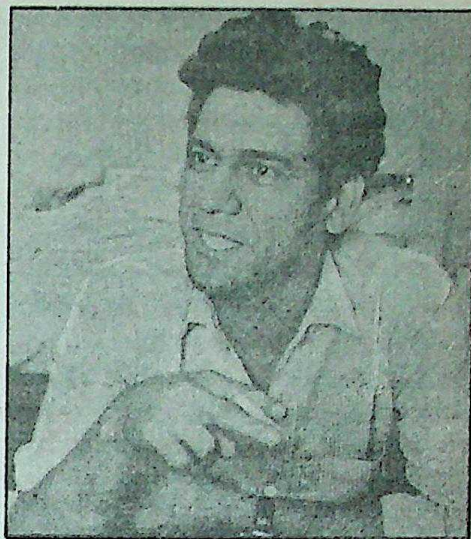
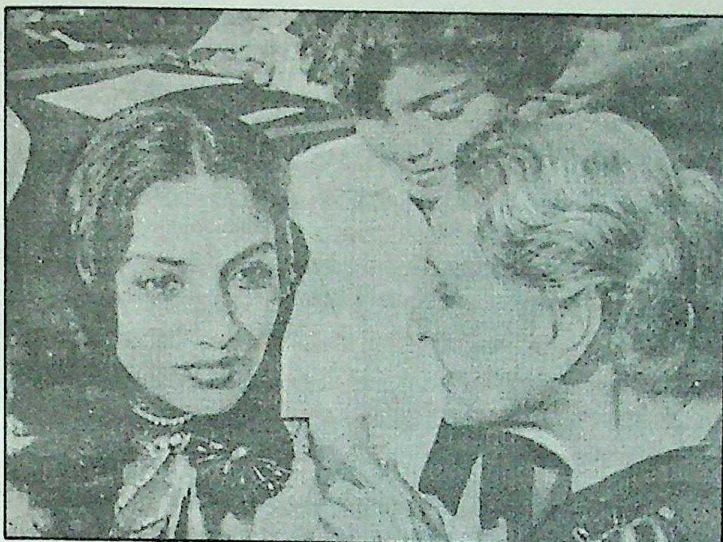
In the large towns and cities often there is not enough waste land within easy reach for the garbage to be dumped untreated. So first something must be done to reduce its volume. And that is done through processes known as pulverization and incineration.

The pulverization is a simple mechanical process whereby the rubbish is pounded into small particles by sheer force. Again the pulverization is of two types: wet and dry. A wet pulverizer consists of a typical rotating inner drum which is fitted with deflector plates, and baffles to pound down the rubbish. This inner drum is made of a grid of alloy steel bars, and once the rubbish has been ground to small bits, it passes between the bars into an outer drum. This drum also rotates and grinds the rubbish still smaller. Although the wet pulverization decreases the volume of the waste, the added water increases its weight. This raises the cost of transport. So the system is economical only when the pulverizer is sited at the rubbish tip itself.

The dry pulverizers are fitted with rotating hammers to crush brittle materials and rotating steel teeth to shred the softer materials such as cardboard etc. These pulverizers can reduce glass to fine powder. They may be vast machines, capable of dealing with over 50 tonnes of rubbish an hour.

The most effective way of reducing the volume of rubbish is the incineration—high temperature burning. In this method, garbage is put into huge furnaces called incinerators, and burnt at a very high temperature. Everything is reduced to ashes, except metals which are collected and may be used again.

In some cities newspapers and rags are separated from the rest of rubbish! These can be pulped to make paper. There is a growing tendency to find new ways of recycling raw materials such as plastics glass and metal, so that they may be used again.



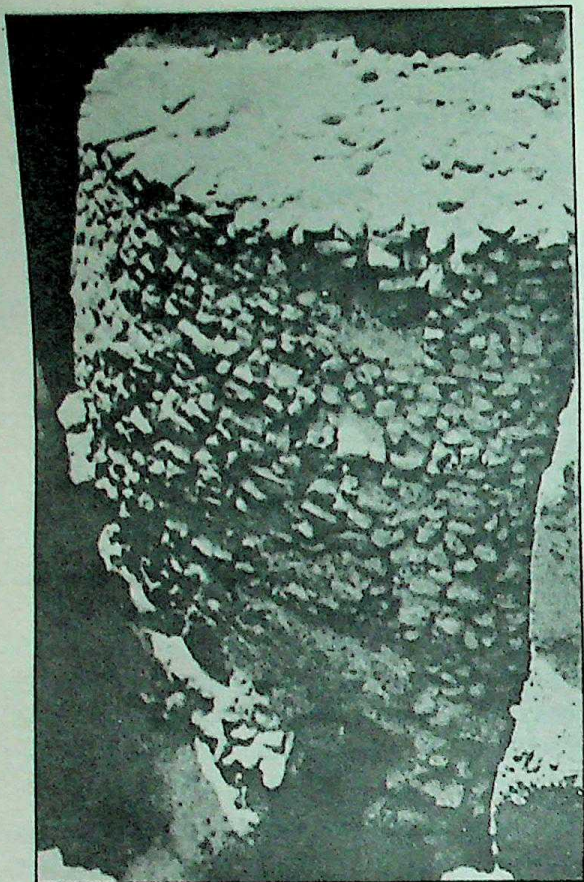
What are the national film awards?

The national film awards were originally instituted in 1953. To begin with there were only two all India film awards—President's Gold Medal for the best feature film, and the Prime Minister's Gold Medal for the best children's film. All the other awards were called the State Awards. In 1966 the State Awards were elevated to the position of National Awards.

In 1970, the Dada Saheb Phalke Award for outstanding contribution to the cause of the cinema, was instituted by the Ministry of Information and Broadcasting. It was instituted as a tribute to the memory of the Father of the Indian cinema. The Dada Saheb Phalke Award consists of a Swarna Kamal (golden lotus) along with a cash prize of Rs. 40,000/- and a shawl. Devika Rani was the first recipient of the Dada Saheb Phalke award. Other winners of the award include B.N. Sirkar, Prithviraj Kapoor, Pankaj Mullick, Sulochna, Kanan Devi, Nitin Bose, Sohrab Modi, B.N. Reddi, music director Naushad and L.V. Prasad.

In 1975 the scope of the awards was enlarged and they came to cover 41 categories consisting of all India and Regional awards. In the same year the Gold Medal was replaced by the Swarna Kamal. The awards of the second order are called Rajat Kamal (Silver lotus). There is one more award known as the Nargis Dutt Award for the best feature film on national integration.

These 41 categories of awards are for best actor, best actress, best child artist, best direction, best information film, best female play back singer, best male play back singer, best music director, best screen play etc. There is a film jury which decides upon the different film awards. These awards are given every year at a function called National Film Festival.



Which is the oldest city in the world?

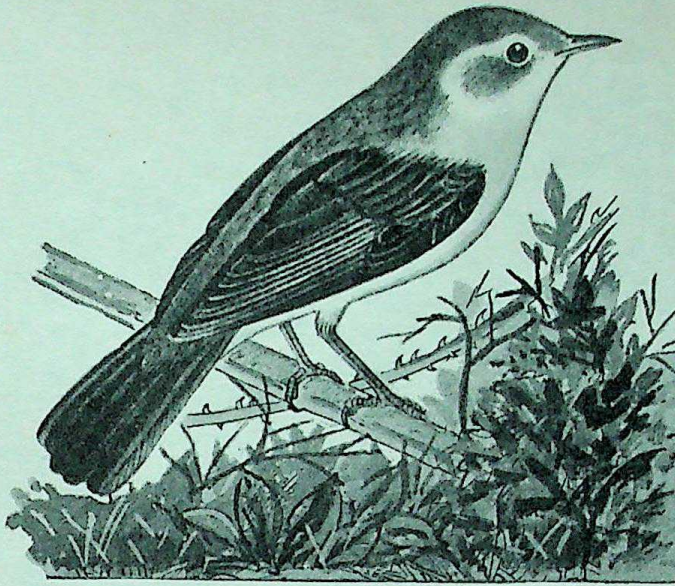
Probably Jericho is the oldest city in the world. It is located on the west side of Jordan near Israel. It is situated 825 ft below the sea-level some six miles north of the Dead Sea. In 1967 it had a population of about 6829.

Jericho's great historical significance is on account of the fact that it has provided archaeological evidence of one of the earliest known continuous settlements in the world, and therefore of the first steps toward civilization dating perhaps to the 10th millennium BC. In the biblical history it is known as the first town attached by the Israelites under Joshua after they crossed Jordan.

Jericho is mentioned in the Old and New Testaments. Herod the Great established a winter residence there and died there in 4 B.C. There is evidence to prove the visit of Mesolithic hunters around 9000 BC, and of a long period of settlement by their descendants. To begin with their habitations included flimsy huts. From these huts solid houses were developed and the settlement spread to cover an area of about 10 acres. By 8000 BC the inhabitants had developed into an organised community capable of building a massive stone wall around the settlement. The size of this walled settlement justifies the use of the term town and suggests a population of some 2000-3000 persons. Thus, in this 1000 years there had been a development from a wandering hunting way of life to an agricultural settlement. For the next 2000 years, Jericho passed through the Neolithic stage. During 5000 BC people of this place started using pottery. Over the next 2000 years, occupation was sparse and possibly intermittent.

At the end of the 4th millennium B.C. an urban culture once more appeared in Jericho as in the rest of Palestine. Jericho became a walled town again with its walls rebuilt many times. About 2300 BC there was once more a break in the urban life. Jericho of the Crusader period was on yet a third site, a mile east of the Old Testament site and here the modern town grew up. Its major expansion, however, came after its incorporation into Jordan in 1949.

The Arab Israeli War of June 1967 resulted in the dispersal of much of the population.



Does the Nightingale sing only at night?

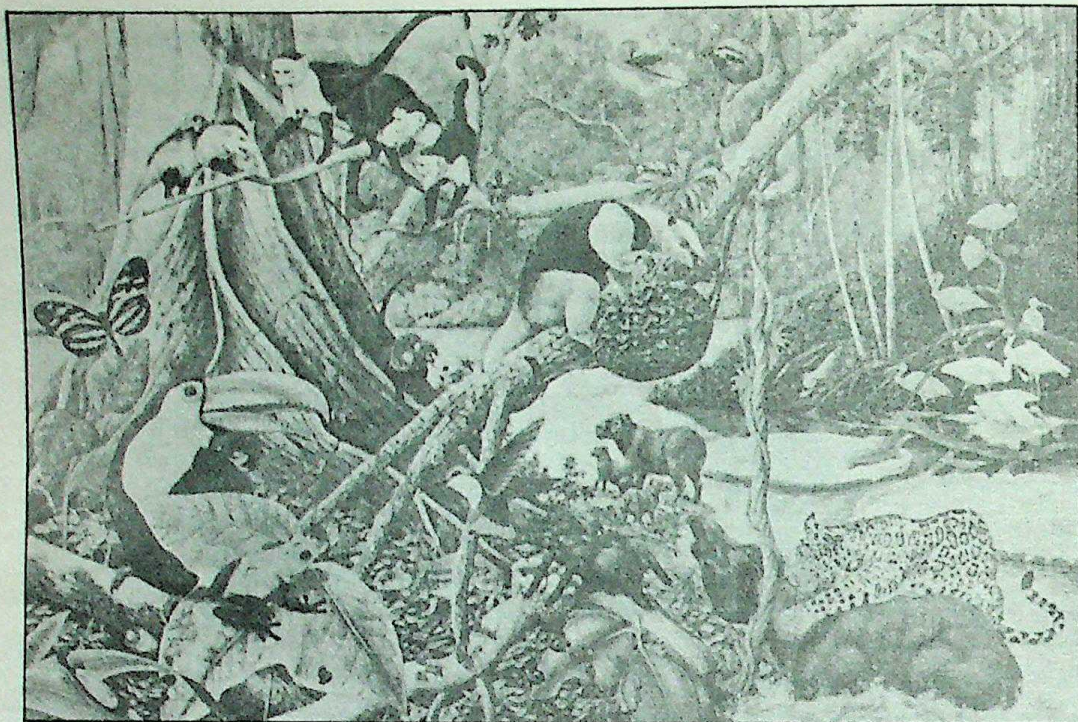
No bird has been written about so much by poets as the nightingale. Aristophanes, the great Greek poet wrote about it in the 4th century B.C. and Keats in the 19th century. The poets have been simply fascinated by the song of this bird. It seems to have something magical about it.

According to poets, the nightingale sings only at night and at almost any season of the year. But this is not true. The nightingale is a migratory bird and in England, for example, can only be heard between the middle of April and the middle of June. It has never been seen in Ireland, Wales or Scotland. In Europe it is found in great number in the South, and even goes as far as Iran, Arabia, Abyssinia, Algeria and the Gold Coast of Africa.

Another surprising fact about this bird is that it is only the male nightingale that sings. The song is to attract the female from the neighbouring bush or tree. It sings in the day as well as the night, but because of the chirping of other birds, his song is distinguishable.

The male's song continues until the female has hatched out her brood. And then he stops to avoid attracting enemies' attention to the nest. He stays on guard. His notes are short calls to tell his mate that all is well, or to warn her of some danger. The male and female resemble each other a great deal—reddish-brown above and dull grayish-white beneath.

The nest of the nightingales is build on somewhat unusual lines. It is placed on or near the ground. The outside of the nest consists mostly of dead leaves set up vertically. In the midst is a deep cuplike hollow, neatly lined with fibers from roots. It is very loosely constructed and a very slight touch can disturb it. One may find in it four to six eggs of a deep olive colour.



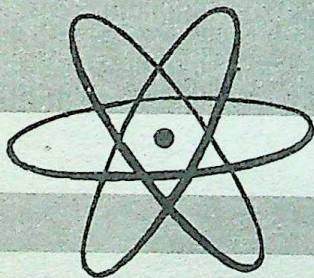
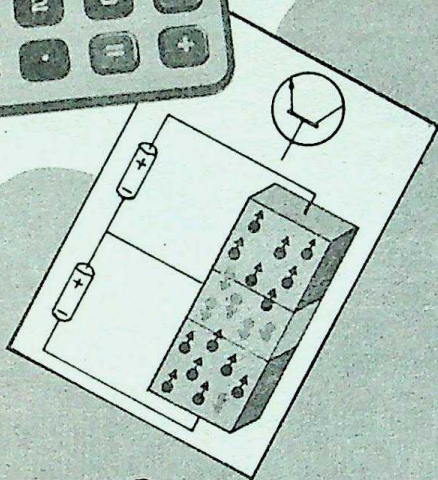
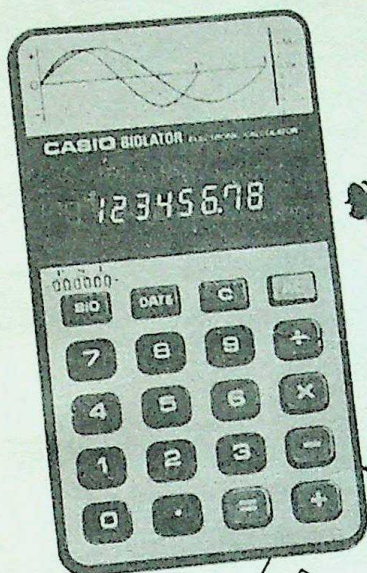
What is a rain forest?

A rain forest is a warm and rainy place which has thick growth of trees. Because of heavy rains, the trees grow tall and close together. The tree tops are so thickly branched that they almost block the wind. The air is still and uncomfortable. The thick tree tops also keep sunlight from reaching the ground. It is quite easy to walk through these areas.

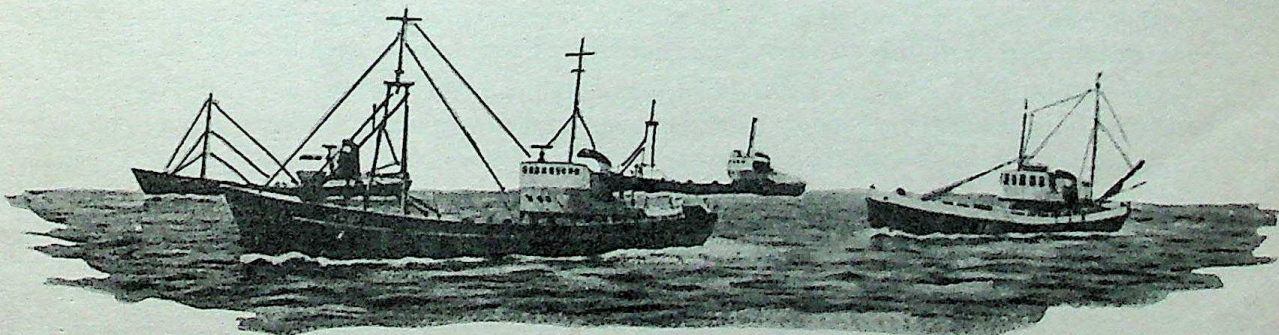
Along with a large number of trees, it also has many different kinds of animals. These include noisy birds, hungry crocodiles, ant eaters, lizards, snakes and jaguars. Thousands of insects of different types are also found in the rain forests. There is an ant called 'army ant' that eats anything that would not move out of its way. There are certain mosquitoes whose bite is fatal; sweat bees which crawl into people's ears and noses, and ticks and flies bite their skin.

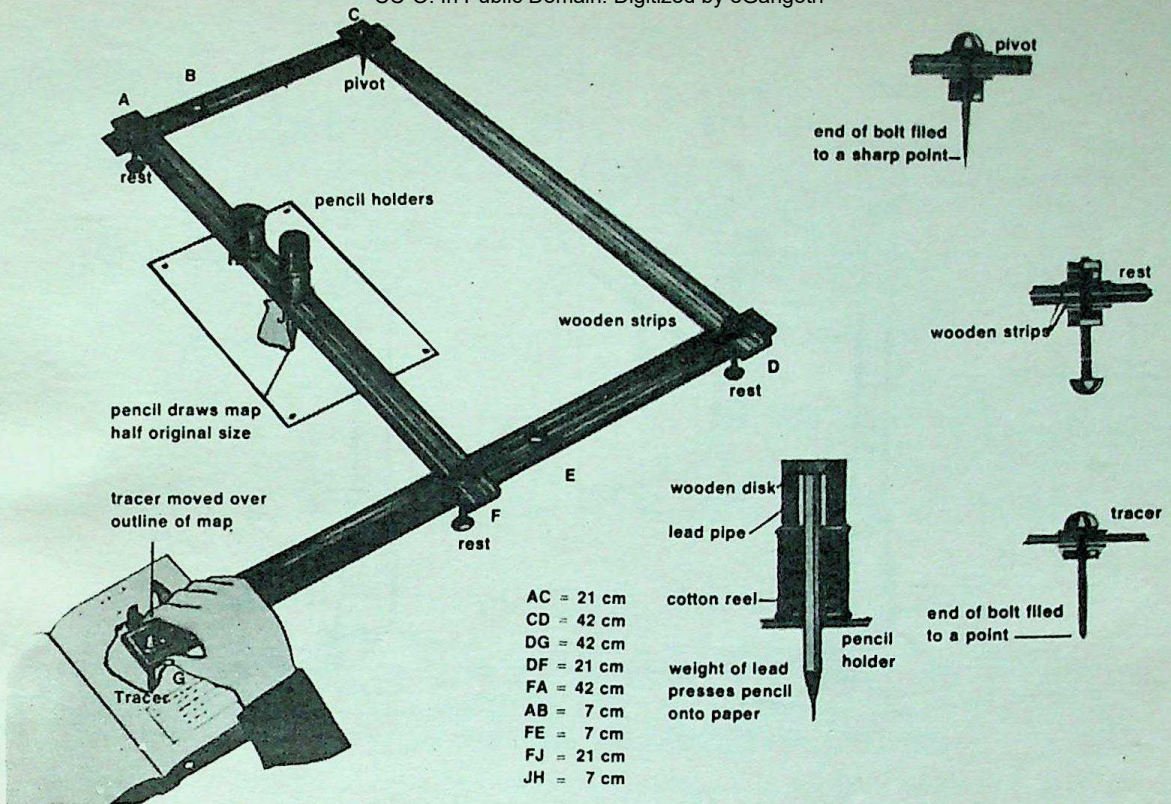
Most rain forests are located near the equator. The temperatures range from about 20 to 34°C. Thunderstorms occur about every three days. Areas of rain forests experience heavy rains upto 250 cms (100 inches). Large rain forests are found in south America, Asia, and Africa. Each of these has similar but distinct species of plants and animals. The tallest trees of rain forest form a covering of leaves called the upper canopy. The upper canopy may be 30 to 46 m above the ground. Smaller trees form lower canopies. The shade from the trees prevents about 99 percent of the sunlight from reaching the ground. Thus there is not much plant life on the forest floor. Dense vegetation close to the ground occurs in clearings and along rivers. These areas are some times called jungles.

There are many different kinds of plant and animal life in rain forests. More different species of trees are found in tropical rain forests than in any other kinds of forests in the world. The soil layer in the tropical rain forests is very thin and not very good for farming.



MODERN SCIENCE





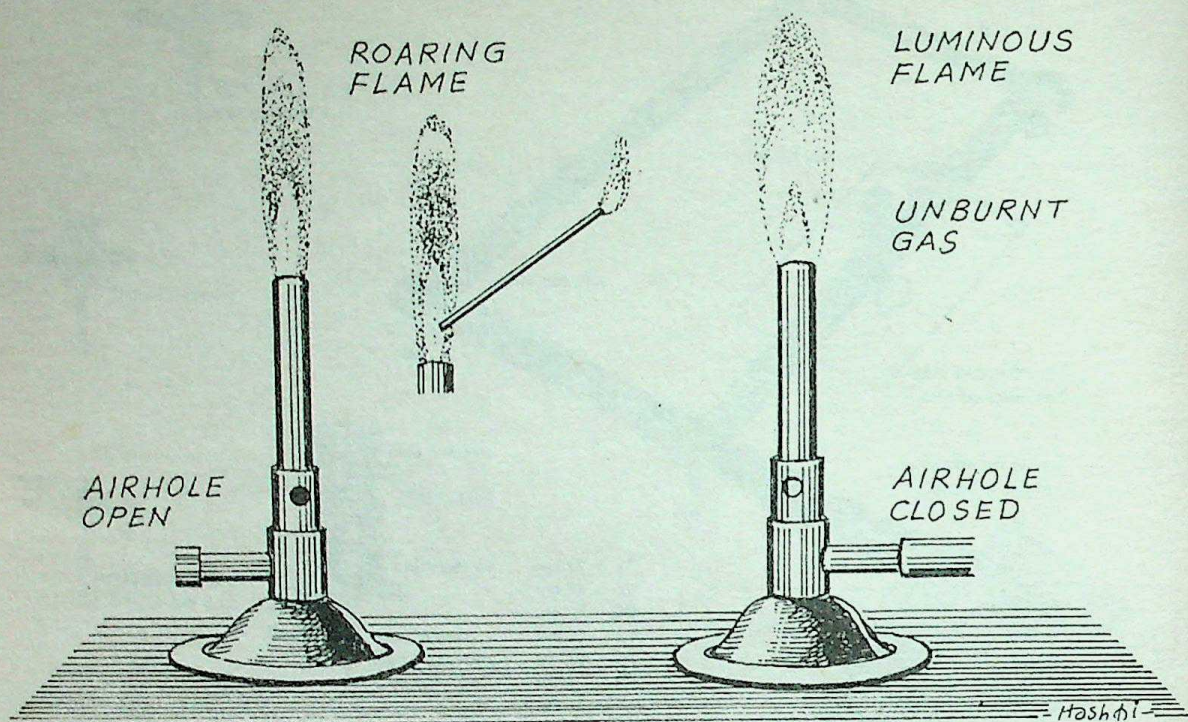
What is a Pantograph?

A pantograph is an instrument used by artists and draftsmen for duplicating or copying a geometric shape to a reduced or enlarged scale on a sheet of paper.

A pantograph is made up of a number of rods. These rods are joined together by pins that can be adjusted. A pointer is moved over the lines of the design or plan. This movement is transferred by the rods to a pencil or pen at the other end. This traces out a copy of the original drawing. The size of the copy can be altered by adjusting the position of the rods. The working of the pantograph can be understood with the help of the figure given above.

In the figure, the links 2, 3, 4 and 5 are connected by pin joints at O, A, B and C. Joint O is fixed to a support, while joints A, B and C are free to move. Link 5 is a solid bar containing on to Q. Point P is the guided point and is usually fixed on link 4. As P is guided on a specific path, such as the square in the figure, point Q will follow a similar path on an enlarged scale. Conversely, if point Q is guided, point P will follow a similar path on a reduced scale.

The links in a pantograph may be arranged in other ways but they all contain a parallelogram. Pantographs are used for reducing or enlarging engineering drawings and maps and for guiding cutting tools over complex paths. The artists specializing in miniatures use pantographs to achieve greater detail in their finished works.



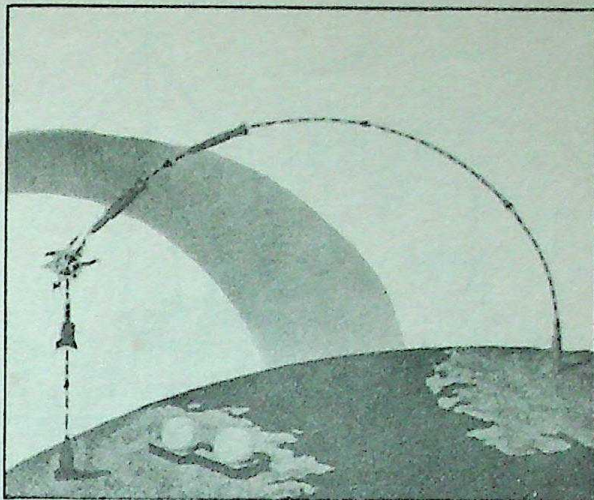
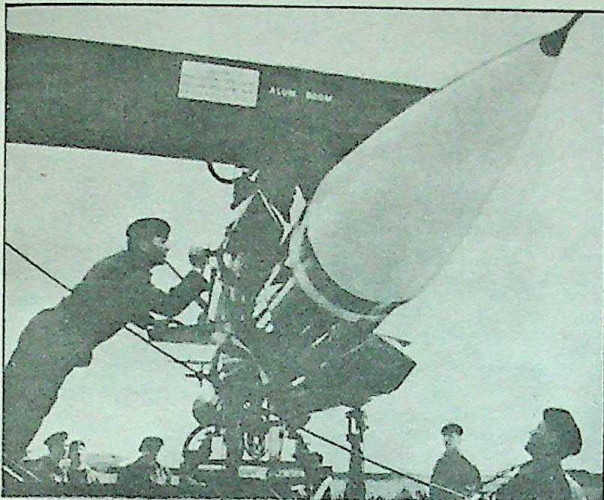
What is a bunsen burner?

The Bunsen Burner is a gas burner used in chemical laboratories to heat various substances. When air and gas mixture (3 : 1) is burnt, it produces a hot non-luminous flame. It was invented by German chemist Robert Wilhelm Bunsen (1811-1899). However, Michael Faraday (1791-1867), the English physicist and chemist, had previously designed a burner that worked on the same general principle.

The Bunsen burner consists of a metal tube fixed over a stand. A rubber tube connects the burner tube to the gas supply. Two adjustable openings at the bottom of the burner regulate the mixing of the air and gas. The gas mixes with the air before burning, allowing the Bunsen burner to produce a flame without smoke. It gives out a hot blue "roaring flame" with the airhole open. The flame has a blue cone in the middle. The hottest point is just above this cone. When the hole is closed partially, the inflow of air is reduced thus making the flame orange and smoky, and less intense.

Because of its effectiveness and intense flame the Bunsen burner has been in wide use since its invention. It is also a simple and inexpensive piece of equipment. Over the years, several modifications and improvements have been made in it. As a result today we have burners with varying sizes and intensity of flames. There are devices for spreading the flame and numerous fittings are made to go on the top of the tube for holding retorts, test tubes etc.

The burners have been devised to burn coal gas, oil gas, acetylene or natural gas.



What is the science of ballistics?

The ballistics is the science concerning the motion and behaviour of projectiles, such as bullets, bombs, rockets and guided missiles. There are three main branches of ballistics. These are: (i) interior ballistics (ii) exterior ballistics and (iii) terminal ballistics.

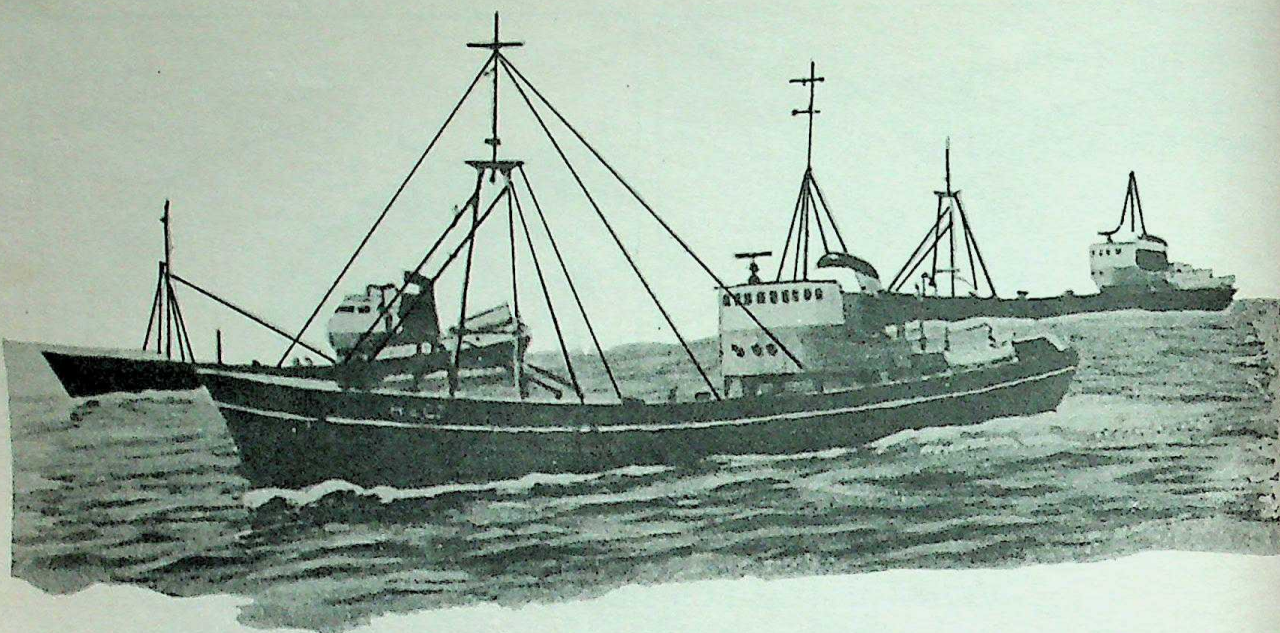
The interior ballistics deal with the motion of a projectile as it travels down the barrel of a weapon, such as a rifle or pistol. The weight of the bullet, the pressure placed on the bullet, the speed at which the bullet moves through the barrel, the barrel's length and diameter, and the speed at which the bullet leaves the barrel all affect the flight of the bullet. A person who studies interior ballistics of a rifle or pistol has to have, a thorough knowledge of all these. The interior ballistics of missiles is concerned with the design of rocket engines and the choice of propellants.

The exterior ballistics is concerned with the flight path or trajectory of a projectile from the time it leaves the rifle or gun until its landing. After the bullet has left the gun, it travels in an arc, falling downwards because of gravity.

The amount of air resistance to a projectile depends on the size, shape and velocity of the projectile and on the density of air. The air resistance slows down the projectile speed and thus reduces the range or distance through which it travels. The winds and crosswinds can affect the range and direction of a projectile. If a projectile is fired from a moving weapon or if the target is moving, the range can be affected. The electronic computers are used to measure the effects of all these factors.

The terminal ballistics is concerned with the effect of the projectile when it reaches its target. The bullets cause damage by penetration. Shell or bomb damage is caused by their explosion. Nuclear missiles produce blast, heat and radiation.

The forensic ballistics is a separate field that helps police to identify bullets. Every gun or rifle makes marks on the bullets it fires. By examining the bullet the experts can find out about the particular gun from which it was fired. Forensic ballistic is very useful in identifying and arresting armed robbers and murderers.

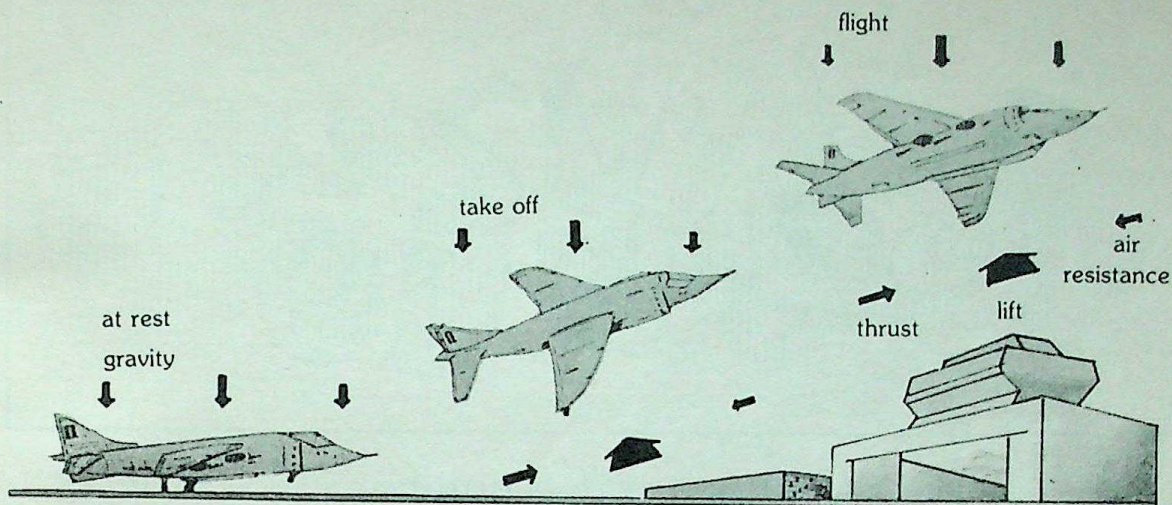


How does a ship made of iron float on water?

It is a well-known fact that a solid block of iron readily sinks in water but an iron ship floats on water. Do you know why an iron block sinks while a ship floats in water?

The iron block sinks because its density is greater than that of water. In fact, for anybody to float, it is essential that its weight must be equal to the weight of the liquid displaced by it. The body's centre of gravity and that of the displaced liquid (centre of buoyancy) must lie in the same vertical line which is called the centre line of the body. In the case of a solid iron block, the weight of the liquid displaced is less than the weight of the block—so it sinks.

The mystery of why an iron ship floats on the water lies in its special hollow construction. Its body is shaped in such a manner that it displaces a large quantity of water, and therefore experiences an upthrust greater than its weight. Therefore, when it floats on the water, its weight is equal to the weight of water displaced by its immersed portion. In other words, when the ship enters the water, the volume of the water displaced is much greater than the volume of actual iron immersed and, as a solid cannot displace more than its own weight of a liquid, the ship sinks until the weight of the displaced water is equal to the weight of the ship. Thus the rest of the portion of the ship stays out of water.



How does an airplane stay up in the air?

An airplane is a heavier-than-air flying machine with fixed wings. When a plane is flying it is being pulled up and down, backward and forward—all at the same time. There are four different forces acting upon it at the same time. These are: (i) weight (ii) lift (iii) thrust and (iv) drag. The weight is the force of gravity that pulls the plane downwards. Lift pushes the plane upward. This force is created by the wings as they cut through the air. The force of 'drag' pulls the plane backward, while 'thrust' pushes it forward. Thrust is produced by propellers. A plane remains steady in flight because of two important reasons: (i) the thrust from its engine equals the drag force; (ii) The lift made by its wings equals the force of gravity on the plane.

An airplane has three main parts: the wings, body and the tail assembly. Its body contains the pilot cockpit and the passenger compartment, and is called the fuselage. The vertical part of the tail assembly is called the rudder. Another part of the tail assembly is the fin. All these movable parts are controlled by the pilot from the control centre of the plane.

The wings lift an airplane into the sky by the pressure of the wind. Ailerons are the flaps on the wings that keep the plane in a curved path during turns. Other flaps on the wings give the plane stronger lift at slower speeds at the time of take off or landing.

The tail assembly keeps the plane steady. The pilot can swing the rudder to the right or to the left. When it swings to the right, the front of the plane moves to the right and when to the left the front of the plane moves to the left. The fin keeps the plane steady in forward flight. The stabilizer keeps the airplane from wobbling up and down in the air. The tail parts called elevators, that are connected to the stabilizer, help the plane go up and down when the plane takes off and lands. The different parts of an airplane have been shown in the figure above.



What is a prime number?

A prime number is that positive integer which is greater than one and divisible only by itself and one i.e. 2, 3, 5, 7, 11, 13, 17, 19, 23—the numbers that cannot be split by division.

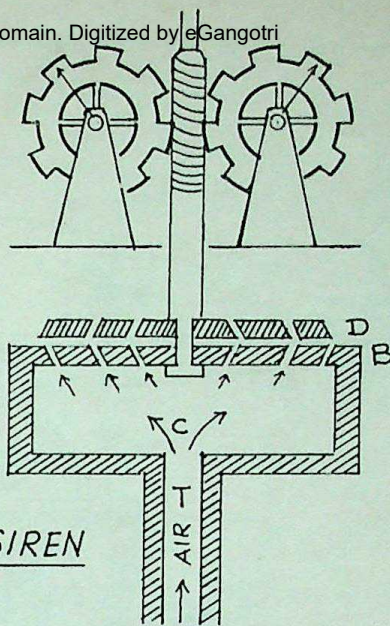
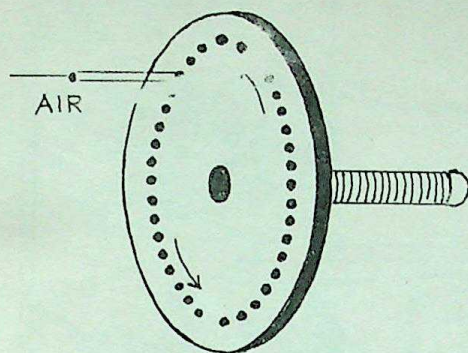
The prime numbers lie at the very roots of the arithmetic and have always fascinated those dealing with figures. For example, choose at random: 17, 23, 29, 41. You can take the sequence as far as you like, and you will never find a prime number divisible by another. Over the centuries, the world's greatest mathematicians have tried to do so and failed. Although they have also been unable to prove that no such number exists.

Every positive integer greater than one can be expressed as the product of only a single set of prime numbers. Despite the fact that prime numbers have been recognised since at least 300 B.C., when they were first studied by the Greek mathematicians Euclid and Eratosthenes, there remain certain open questions regarding them.

There is an infinity of prime numbers, and in theory anything may happen in infinity. But so far the theorists have not been able to even find a rule governing the gaps between prime numbers, which still remains a great mathematical mystery.

DISC SIREN

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COGNAIRE DE LA TOUR'S SIREN

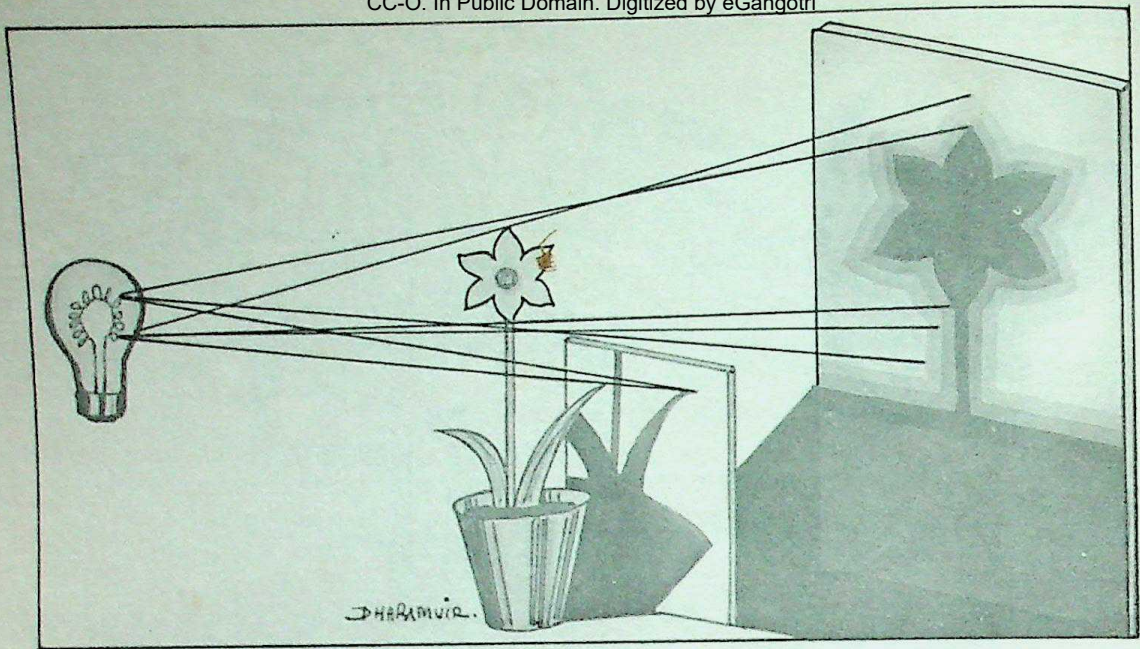
How does a siren produce sound?

A siren is a device basically used to make a warning or a signal. It gives off a loud, piercing sound of a definite pitch. It is powered by electric motors, steam or hand cranks. Today sirens are generally used in the factories.

The siren was invented in the late 18th century by a Scottish natural philosopher, John Robison. It was named thus by a French engineer, Charles Cognaire de La Tour, who devised an acoustical instrument of the type in 1819.

The Cognaire siren consists of a cylindrical hollow box 'C', known as the wind chest. It has a fixed top lid 'B' that consists of a number of equidistant slanting holes arranged in circles. The chest is fixed at its lower end with a tube 'T', through which air can be blown in it by means of bellows. Another disc 'D' of the same size, with equal number of equidistant holes slanting in the opposite direction, covers the first disc. This disc can be rotated by a mechanical arrangement. The air under pressure is forced into the wind chest of the siren due to which the disc begins to rotate. The air passes through the holes in the lower disc, and comes out through the holes in the upper disc. Every time the holes in the upper disc are above the holes in the lower disc, a puff of air escapes. This creates a sound. The pitch of the sound depends upon the speed at which the disc rotates.

Now even improved versions of this siren are available. This type of siren uses two small cylinders (one cylinder inside the other) which have holes in them. An electric motor rotates the outer cylinder. Another device forces air or steam through the cylinders. The holes in the cylinders are actually small slots which are cut on a slant in lines encircling the cylinders. The air enters the slots in the first cylinder, and then passes through the slots in the second cylinder. Every time the slots exactly are opposite one another, a noise is created by this movement of air through the slots. The faster the rotation of the outer cylinder, the louder the sound.



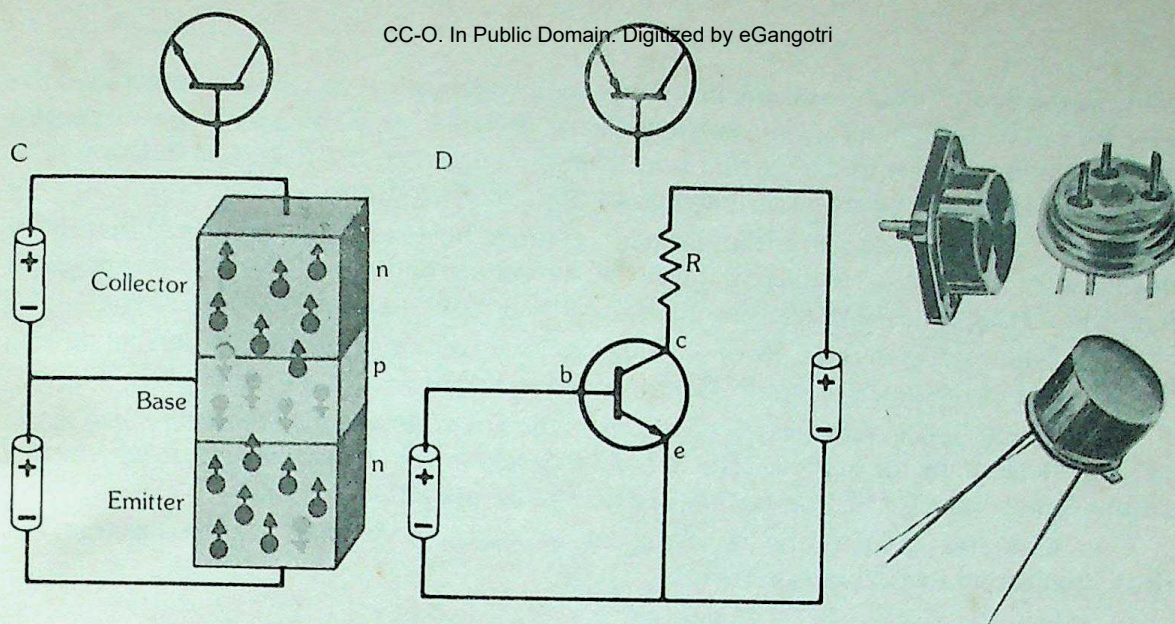
What is a shadow?

A shadow is formed when light is incident on an opaque object and cannot penetrate into the space immediately beyond it. In other words, a shadow is that part of illuminated surface which is shielded from oncoming light rays by an object through which the light cannot pass.

The extent and the shape of a shadow mainly depends on the size of the source of light. If the source of light is very small the outline of the shadow will be sharp and well-defined and its shape that of the object producing it. But if the source is large, the shadow will be very dark in the middle and lighter on the outside with indistinct outlines. The dark part of the shadow is called umbra and the lighter penumbra.

The shadows cast by the sun always have a penumbra and the shape of the shadows cast varies with the position of the sun in the sky and the angle of rays. An upright pole will cast a long shadow in the morning when the sun is rising but will grow shorter with approaching noon. As the sun declines in the sky, the shadow grows longer again.

The human shadows have often had a mystical or magical significance.



How does a transistor work?

A transistor is a tiny electronic device used to control and amplify an electrical signal. It is used in many electronic circuits in place of vacuum tubes. Today transistors are being widely used in computers, hearing aids, stereos, radios, televisions and satellites.

Transistors are smaller, light-weight, more dependable, long-lasting and less expensive devices than vacuum tubes. They consume comparatively less amount of electricity and hence can be operated on small batteries.

The transistor was developed by three American physicists, John Bardeen, William Shockley and Walter Brattain in 1948. For their research they were awarded Nobel Prize for physics in 1956.

A transistor is made of a semiconductor—silicon or germanium. There are two basic types of transistors: junction transistor and field-effect transistor. In a junction transistor, one type of semiconductor is placed between two layers of the other type. If the middle layer is 'p' type semiconductor, and other two layers are of 'n' type semiconductor, the transistor is known as 'npn' transistor. Similarly, if the middle layer is of 'n' type semiconductor and other two layers are of 'p' type, the transistor is known as 'pnp' transistor.

Here it is important to know that a 'p' type semiconductor is obtained by doping 3rd group elements like boron, aluminium or indium in silicon or germanium. Similarly a 'n' type semiconductor is made by doping 5th group elements like phosphorus or arsenic in silicon or germanium. The middle layer of a transistor is called base. One outside layer is called emitter and the other layer collector. The transistor has two junctions, one where the base and emitter connect, the other where the base and collector touch.

In a 'npn' transistor, the voltage of the base must be more positive than the voltage of the emitter. The voltage of the collector, in turn, must be more positive than the voltage of the base. In this way, the negatively-charged electrons move from the emitter, through the base to the collector. This flow of electrons produces a current. The number of electrons in the base

controls the flow of electrons from the emitter to the collector. A voltage is connected to the base to control the number of electrons in the base. A slight increase in this voltage will cause a much greater increase in the current flow from the emitter to the collector. In this way, a transistor can amplify a signal to many times of its original strength.

In the 'pnp' transistor, it is the positively charged holes (and not electrons) that move from emitter to collector. In the pnp transistor, the voltage of the base must be more negative than the voltage of the emitter. The collector is also more negative than the base.

In a field-effect transistor, there are only two layers of semiconductor. A current flowing through one of the layers is controlled by a voltage connected to the other layer.

In the early 1960s, scientists developed a method of making many transistors on a single piece of semiconductor material. This led to the development of complete electronic circuits on one semiconductor. These circuits are known as integrated circuits.

As a matter of fact, the development of low cost & small size transistors has revolutionised the world of electronics.

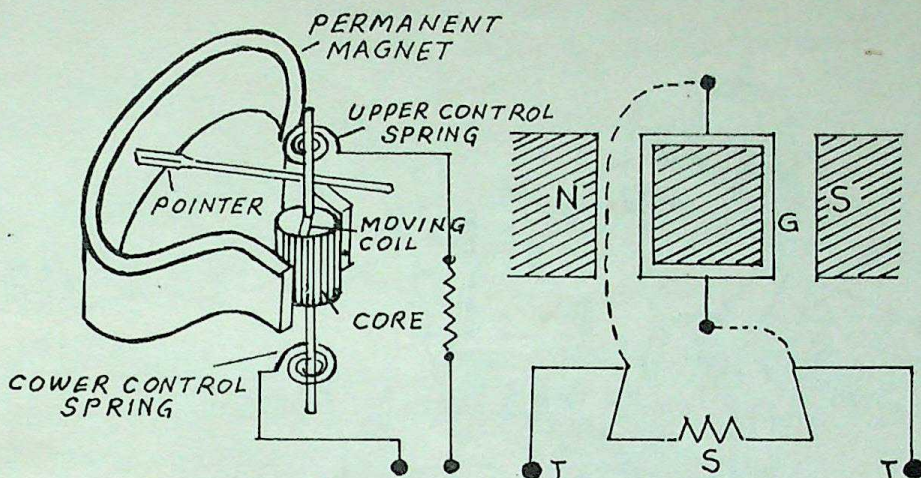
What is a Clinometer?

A clinometer is an instrument used by surveyors and civil engineers to measure the inclination angle of slopes and hills by reference to a plumb bob or spirit level. It is also used to measure the height of an object if the distance from the observer to the object is known. A clinometer is also called Abney level.

It consists of a sighting tube surmounted on a graduated vertical arc with an attached spirit level. A 45° mirror inside the tube enables the observer to see the bubbles at the same time that the observer sights a point or a graduated rod with a horizontal wire. The surveyor first makes sure that the bubble is in the middle of the spirit level tube. This indicates that the clinometer is being held in a horizontal position. He or she looks through the eyehole and adjusts the vertical arc to coincide with the sighted point. The vertical angle is indicated on the arc.

In the 'plumb-bob' clinometer, a plumb bob or a weight attached to a piece of string hangs from the sighting device. As the device is tilted upward to view the top of the hill, the string moves across protractor like face and indicates the angle of inclination.

The clinometer is mainly used to measure the slope angles. If set on a slope it can be used to give the angle of inclination of the surface. With the arc set at 0° , it can be used as a hand level.



What is an ammeter?

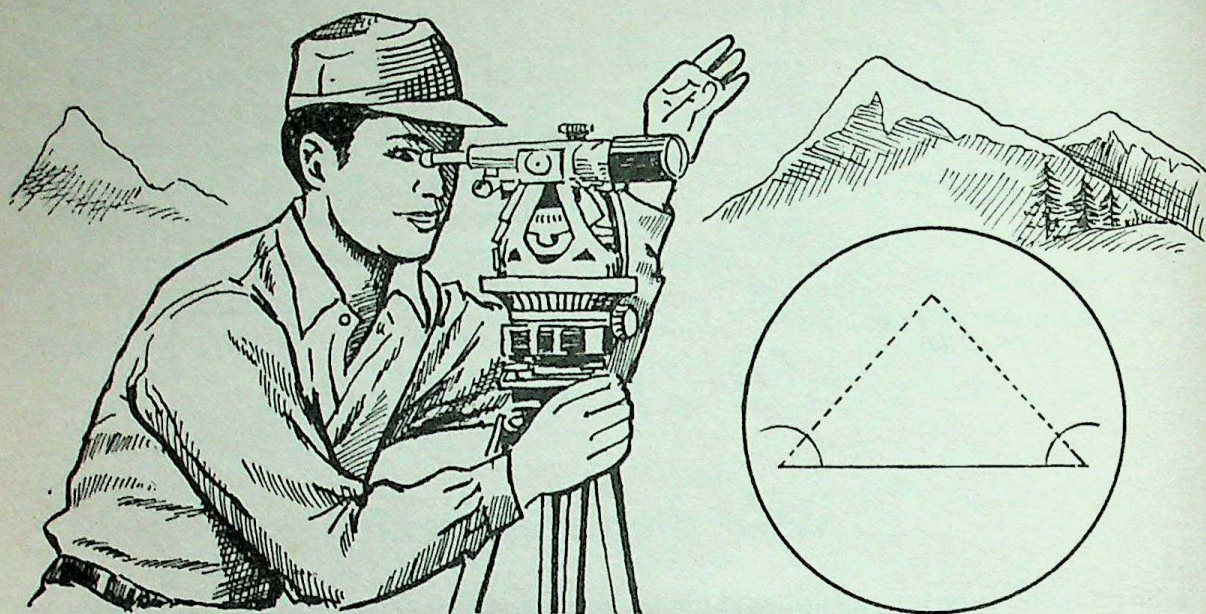
The ammeter is an instrument used for measuring electric current. The current is measured in amperes. There are three main kinds of ammeters: (i) moving coil ammeter (ii) moving iron ammeter and (iii) a hot-wire ammeter.

The moving coil ammeter is like a galvanometer. It has a coil of wire between the poles of a permanent magnet. As electric current passes through the coil, it creates a magnetic field around the coil. The field of the coil and the field of the magnet make the coil move. A needle attached to the coil moves in accordance with the coil movements. The movement of the needle is proportional to the amount of current flowing through the coil. The moving-coil ammeter can measure only direct current, not the alternating current. A rectifier is added to the moving coil ammeter if the alternating current is to be measured.

The moving-iron ammeter has two pieces of iron inside a coil. One of the iron pieces can move. The other piece cannot move. The current passing through the coil produces a magnetic field. The force of the field moves one piece of iron away from the other. A needle on a scale indicates the current. These ammeters can measure both direct and alternating current.

A hot-wire ammeter measures the heat produced by an electric current passing through it. The electric current heats a wire, causing it to expand. A needle is attached to indicate how much the wire expands.

The ammeters are used where electrical power is in use. They are common in automobiles and appliances as well as in larger machines that use electricity.



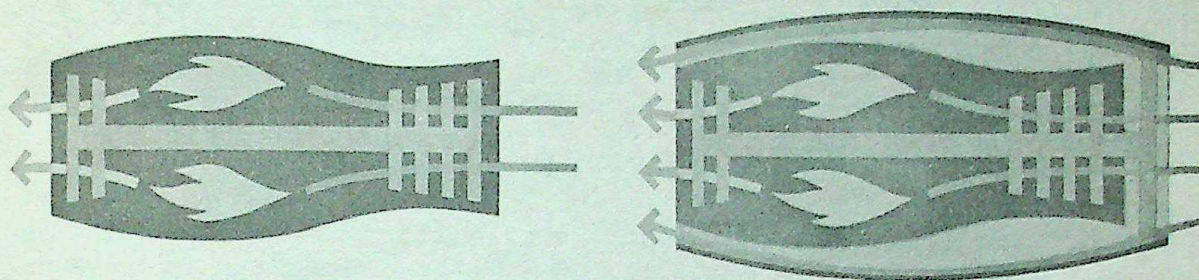
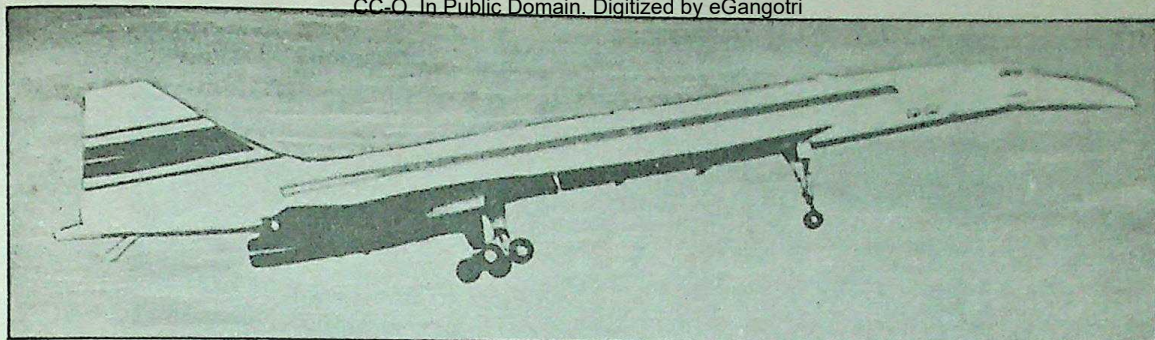
What is a theodolite used for?

A theodolite is a survey instrument used for measuring horizontal and vertical angles. Through this the map makers can measure distances and directions to relate different places on the earth's surface to each other. It is also used for precise angular measurements in road building, tunnel alignment, and other civil engineering work. Through this the astronomers can measure the angle of the moon above the horizon at two places on the earth's surface. It is called the system of triangulation. From these angles they can determine the distance of the moon from the earth. Do you know what this instrument is?

This instrument was developed in the 16th century by the English mathematician Leonard Digges. Over the years many modifications have been made in it. In its modern form, it consists of a telescope mounted to swivel both horizontally and vertically. Levelling is done with the help of a spirit level. The cross hairs in the telescope eyepiece permit accurate alignment with the object sighted. When the telescope is adjusted precisely, the two accompanying scales, vertical and horizontal, are read to give accurate readings of the angles.

Theodolite is mounted on a tripod to obtain precise measurements (see figure above). The transit is a variety of theodolite that has the telescope mounted in such a manner that it can be completely reversed or transited.

The phototheodolite is a combination of camera and theodolite mounted on the same tripod, used in terrestrial photogrammetry for map making and other purposes.



How does a jet plane work?

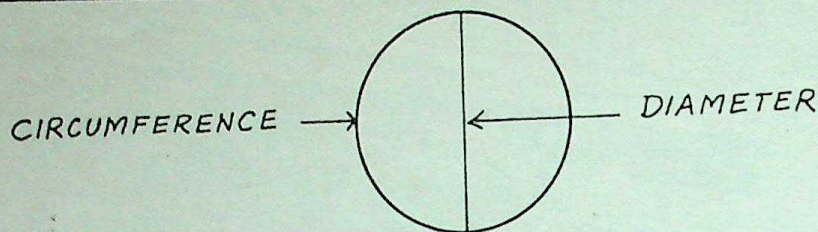
A jet plane is an aircraft that has a jet engine. When the fuel is burned inside a jet engine, great amount of hot gases are produced almost instantly. It is like an explosion. The gases shoot out from the back of the engine in a jet-like stream through an exhaust nozzle. The stream rushing out toward the rear causes an opposite reaction and makes the plane move forward. This forward force is called thrust. If you observe a toy balloon filled with air you would see how a jet engine works. If you suddenly let go of the stem of the balloon, the balloon will zip away. Air rushes from the stem in one direction, pushing the balloon in the other direction just like the jet plane.

The rockets also work on the same principle. The difference between jets and rockets lies in the source of the oxygen to burn the fuel. A jet engine uses oxygen in the air around it. It sucks in the air to burn its fuel through what is called an intake nozzle. A rocket has no intake nozzle. It carries its own oxygen. The oxygen may be in the form of liquid oxygen in a tank. It may be part of a solid fuel a rocket burns.

The jet engines of airplanes have turbine compressors which are driven by the exhaust gases. The air sucked in through the intake is squeezed together or compressed before it is mixed up with the fuel. This increases the force of the explosion within the engine.

The world's first military jet was the German Messerschmitt Me 262 which went into the air as a light bomber in 1944, and the first jet airliner was the de Havilland Comet, which made its first commercial flight on 2 May 1952.

The jet can reach a speed more than 3500 kms per hour. A plane with two jet engines can go about 900 kms per hour. Some jet planes with four engines can fly at a speed of more than 1600 kms an hour.



$$\frac{\text{CIRCUMFERENCE}}{\text{DIAMETER}} = \pi (3.14 \dots \frac{22}{7} \text{ Approx.})$$

Why is 'pi' π such a unique number?

The 'pi' π is a unique number and defined as the ratio of a circle's circumference to its diameter. This number is independent of the size of a circle and for all practical purposes its approximate value is taken as $22/7$ or 3.1416 . In fact, the fraction $22/7$ is slightly greater in value than pi.

For many centuries the mathematicians have been fascinated by its unique characteristic. The strangest thing about this number is that nobody has been able to calculate its exact value. Computer scientists have now computed pi to over one million decimal places. It looks like this; $3.14159265358979323846264338327950288419$.

At one time the scientists tried to prove that pi was a fraction. When any fraction is written in a decimal number, the same digits always appear over and over again in a special pattern. For example the approximate value of pi i.e. $22/7$ when written in decimal numbers works out to be 3.142857142857142857 . If pi were a fraction, there would be a repeating pattern to its digits. But strangely enough a repeating pattern in pi could not be found. Finally in 1761, a Swiss mathematician named Johann Heinrich Lambert settled the matter once and for all. He proved that pi is not a fraction.

Now the question arises what is the significance of pi in our daily life. Suppose you have an automobile tyre whose diameter is one metre. If you want to find its circumference, you can find out by measuring with a tape. Another way of finding the circumference is to multiply the diameter by this strange number 'pi'. This number is used to calculate the circumference of all the circular objects.

The mathematicians are still engaged in research in this direction to see if the digits are arranged in any special way.



What is a Cosmic Year?

The cosmic year is related to the motion of a galaxy. A galaxy is a large system of stars held together by gravitational force. There are millions of galaxies in the universe. The size of a galaxy is measured in the unit of light year. The diameters of different galaxies range from a few thousand light years to 500,000 light years.

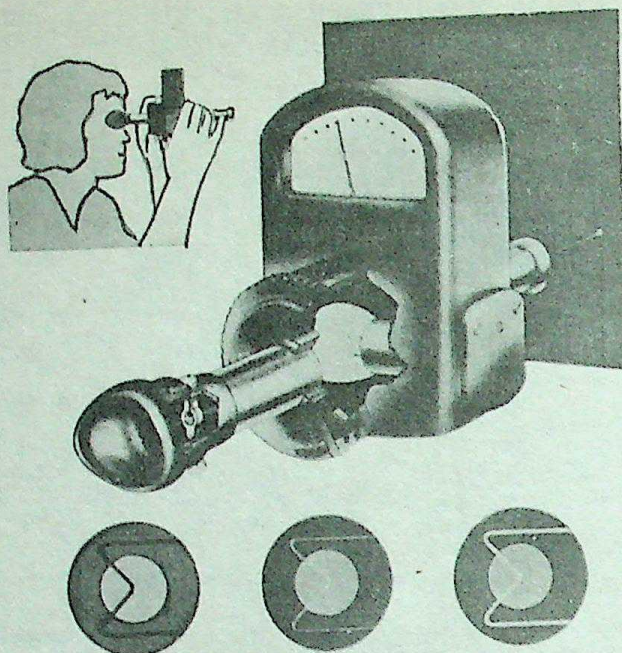
There are three main types of galaxies: the spiral galaxies, elliptical galaxies and irregular galaxies. The spiral galaxies are generally disc-shaped with curving arms extending from a centre bulge. The elliptical galaxies are shaped like spheres or flattened spheres. The irregular galaxies have no definite shape.

The Milky way or Akash Ganga is a spiral shape galaxy. Our solar system belongs to this galaxy. The sun is one of about 100,000 million stars located in the Milky Way. The modern estimates place the sun at a distance of about 32,000 light years from the centre of the galaxy.

The Milky Way is not stationary. It is rotating round an axis passing through its centre. This is the real reason for its flat disc like shape. The whole disc of the galaxy rotates about its galactic centre—but not at a uniform speed. The rate of rotation decreases with increasing distance from the centre. The galaxy does not rotate like a solid wheel.

Each star revolves around the central nucleus in an elliptical or circular orbit, just like the planets revolve round the sun. The stars near the centre move faster than the stars farther out. Our sun moves round the centre of galaxy at a speed of 250 km per sec. The sun takes about 225 million years to complete one revolution around the galactic nucleus. This period is known as the cosmic year or the galactic year.

There is evidence of galactic rotation in observations that in general stellar motions are not random, but in preferential directions. The Dutch astronomer J.C. Kapteyn first observed this effect in 1904.



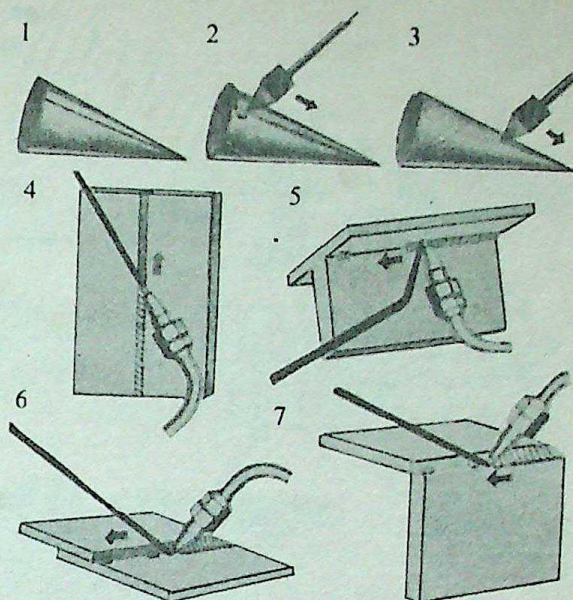
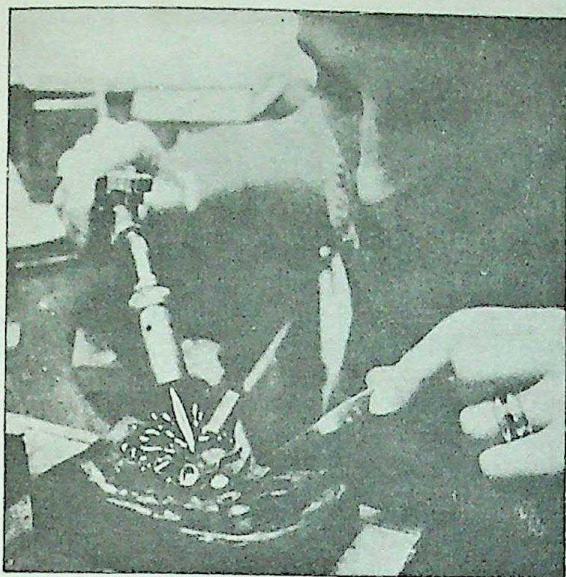
What is a Pyrometer?

A pyrometer is an instrument used for measuring high temperatures—especially those which can't be measured through ordinary thermometers: for example, pyrometers are used to measure temperature in a furnace.

There are two main kinds of pyrometers : (i) the radiation pyrometer and (ii) the optical pyrometer. In an elementary radiation pyrometer, the radiation from the hot object is focussed onto a thermopile, a collection of thermocouples. When the thermopile gets heated due to the intercepted radiation, it produces a voltage. The amount of voltage developed depends upon the temperature. Proper calibration permits this electrical voltage to be converted into the temperature of the hot object.

Sometimes a bolometer is used instead of a thermopile. A bolometer has two strips of the metal platinum. When the platinum strips heat up, the electrical resistance of the strips changes. The change of resistance can be used to measure the temperature. Such pyrometers are sometimes called resistance pyrometers.

The optical pyrometers use the light coming from a hot object to measure its temperature. Optical pyrometers, for example, measure the temperature of incandescent bodies by comparing them visually with a calibrated incandescent filament that can be adjusted in temperature. We know that brightness and colour of the light change with the temperature of the object. The light is compared to the light from a tungsten filament lamp. The filament is seen against a background of light from the object. The voltage through the filament is varied. The changing voltage heats or cools the filament, and makes it brighter or dimmer. At a certain voltage, the filament disappears in the background because the two colours are the same. The size of the voltage through the filament can be used to measure the temperature.

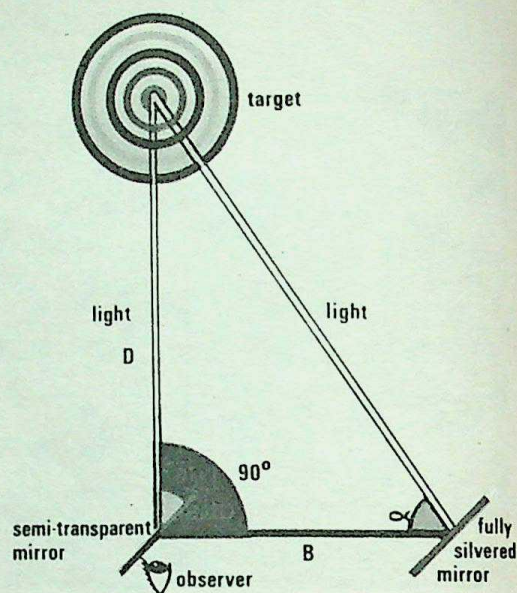
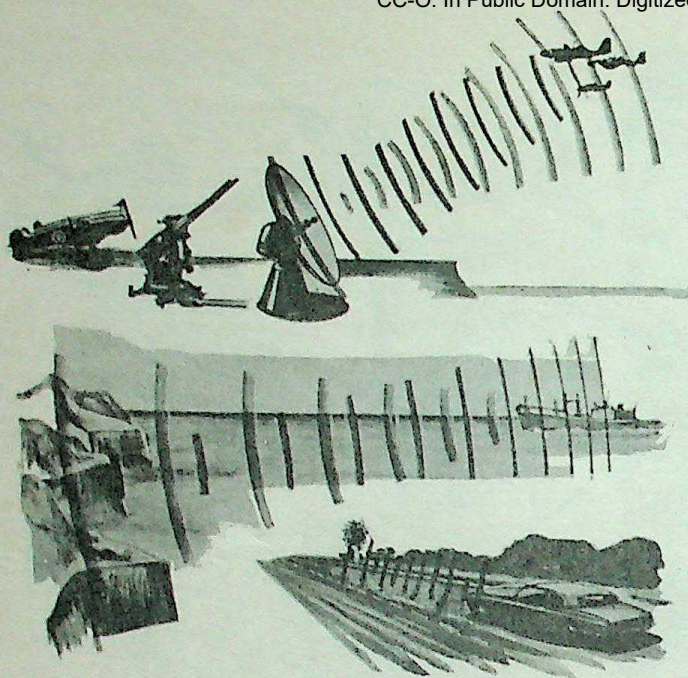


What is a welding or a cutting torch?

A mechanical device that mixes gases and produces a hot flame for the welding or cutting of metals is called a welding or cutting torch. This torch usually produces a flame temperature of 2750°C to 3300°C by mixing acetylene and pure commercial oxygen. The temperature it produces is sufficient to melt the metal locally. The torch thoroughly mixes the two gases and permits adjustment and regulation of the flame.

Welding torches are of two types : low pressure and high pressure torch. On a low pressure or injector torch, acetylene enters a mixing chamber, where it meets a jet of high pressure oxygen. The amount of acetylene drawn into the flame is controlled by the velocity of this oxygen jet. In a high pressure torch both the gases are delivered under pressure. Heat developed at the work is controlled principally by the size of the nozzle or the tip fitted onto the torch. The larger the tip, the greater the required gas pressure. Small flames are used with thin-gauge metals. Large flames are necessary for thick metal parts.

A welding torch mixes the fuel and gas internally and well ahead of the flame. For cutting, the torch delivers an additional jet of pure oxygen to the centre of the flame. The oxyacetylene flame produced by mixed gases raises the metal to its ignition temperature. The central oxygen jet oxidizes the metal, the oxide being blown away by the velocity of the gas jet to leave a narrow slit or kerf. The temperature for the cutting action, once initiated is maintained by the oxidation of the metal. Nowadays automatic torches have been developed for precision cutting and welding.



What is a range finder ?

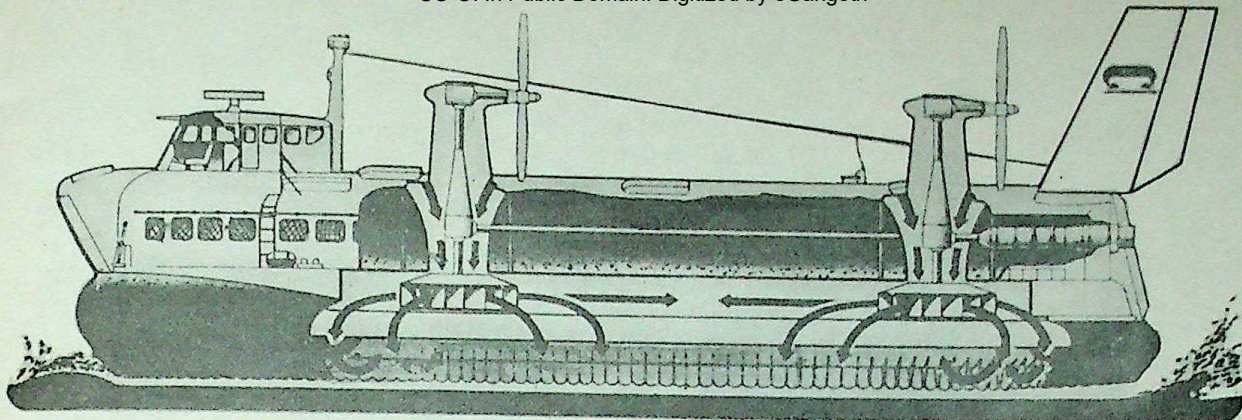
A range finder is an instrument used to measure distances for a number of purposes. They are used by surveyors and the army. They are mainly of two types: optical range finder and laser range finder. The radar is also a form of non-optical range finder. It measures the time lapse of an electromagnetic echo and translates the time into distance.

The military range finders are usually long tubes with eyepieces at the centre. The lenses and prisms are located at each end of the tube. The operator looks through the eyepiece and adjusts the prisms so that the target can be sighted through both ends of the tube. The difference in direction of the two lines of sight from the ends of the tube is called the parallax angle. The angle depends upon the distance of the target. The angle is measured on a dial from which the distance of the target can be read directly.

There are two types of optical range finders: coincidence and stereoscopic. In the coincidence range finder, the operator looks through a single eyepiece and sees two images of the target. By turning a knob, these two images move together. When this happens, the distance to the target can be read on a dial.

The operator of a stereoscopic range finder looks through a pair of eyepieces. One sees a single image of the target, and also a marker that seems to be floating in space near the target. The operator turns a knob until the marker seems to be the same distance away as the target. Then the distance is read on a dial.

The laser range finder works on the principles of radar. In this a beam of laser is sent towards the target and the reflected beam is received by the receiver. The time taken by the laser beam from the range finder to the target and back is measured. This time when multiplied by the velocity of laser beam gives a reading that's double that of the distance of the target. These range finders have automatic arrangements for showing the distance of the target.



How does a hovercraft work?

The hovercraft is an entirely new form of transport, and is quite different from any ordinary vehicle, ship or aeroplane. However, the hovercraft combines many of the features of all the three. It can carry heavy loads over land, can operate on the sea and is airborne in operation.

The hovercraft hovers, or rides on an air cushion. So it's sometimes also called air-cushion vehicle or ground-effect machine. If a vehicle can be made to float on a cushion of air, it can be easily moved in any direction by a little force. Most of the air cushion vehicles are used for travelling over water. They can move very fast, even upto a speed of 150 km per hour. These vehicles can travel at such high speeds because they do not have any resistance on account of water. Comparatively an ordinary ship would travel slowly because it is slowed down by friction between the hull and the water. In a hovercraft, the air is sucked in through the top of the vehicle by a large fan. It is then blown through nozzles to the bottom of the hovercraft.

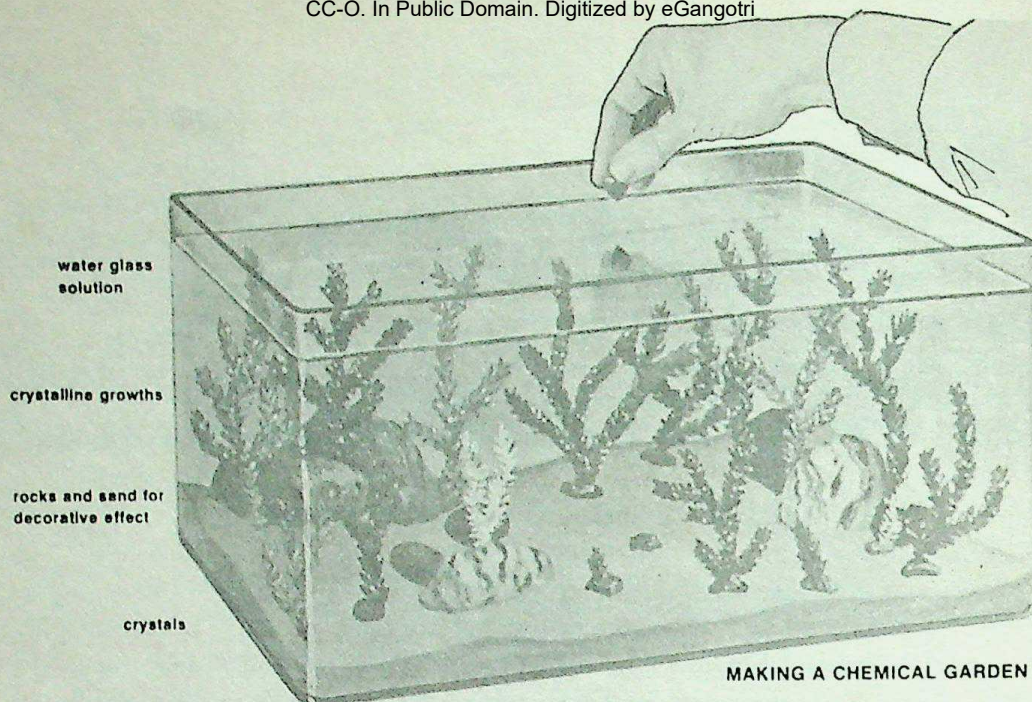
The different parts of a hovercraft are shown in the figure above. It consists of an oval or rectangular plenum chamber which is flat at the top. The cabin, engine, control gear and plenum-chamber air intake are all fitted above the floor formed by the top of the plenum chamber. With single-engined vehicles, the air intake and engine are at the rear, and the passenger or freight compartment forward. The air intake is as high as possible to avoid the entry of spray or dust.

The buoyancy tank is fitted within the plenum chamber in such manner that there is a space over its top and an air slot around its edges. The whole of the space through which the air cushion flows is finished with flush-headed rivets, smooth bends and smooth edges to ensure an uninterrupted air flow and maximum cushion efficiency.

A system of control rudders and tail-planes are mounted at the extreme rear.

The lift fan sucks the air from the top and this air is blown through the nozzles to the bottom of the hovercraft. This lifts up the vehicle. The hovercraft travels by means of propellers driven by engine. The propellers face backwards, and by swiveling them the vehicle can be steered. Some hovercrafts have large vertical tail fins and are steered by turning the fins to either side.

Because of high speed, the air-cushion vehicles are very useful for carrying passengers and freight between ports. They are only used for fairly short distance, since they cannot travel in rough seas. The air-cushion vehicles are also very useful for travelling over swamps.



What is water glass?

Water glass, as the name implies, is a kind of soluble glass. We know that sand is mainly made up of a compound called silicon dioxide or silica. When it is heated with sodium carbonate, a colourless, glassy solid is formed. This solid is made up of a mixture of various sodium silicates. It can be dissolved in water to form a thick, colourless liquid called water glass. The water glass can also be prepared under pressure using silica and caustic soda.

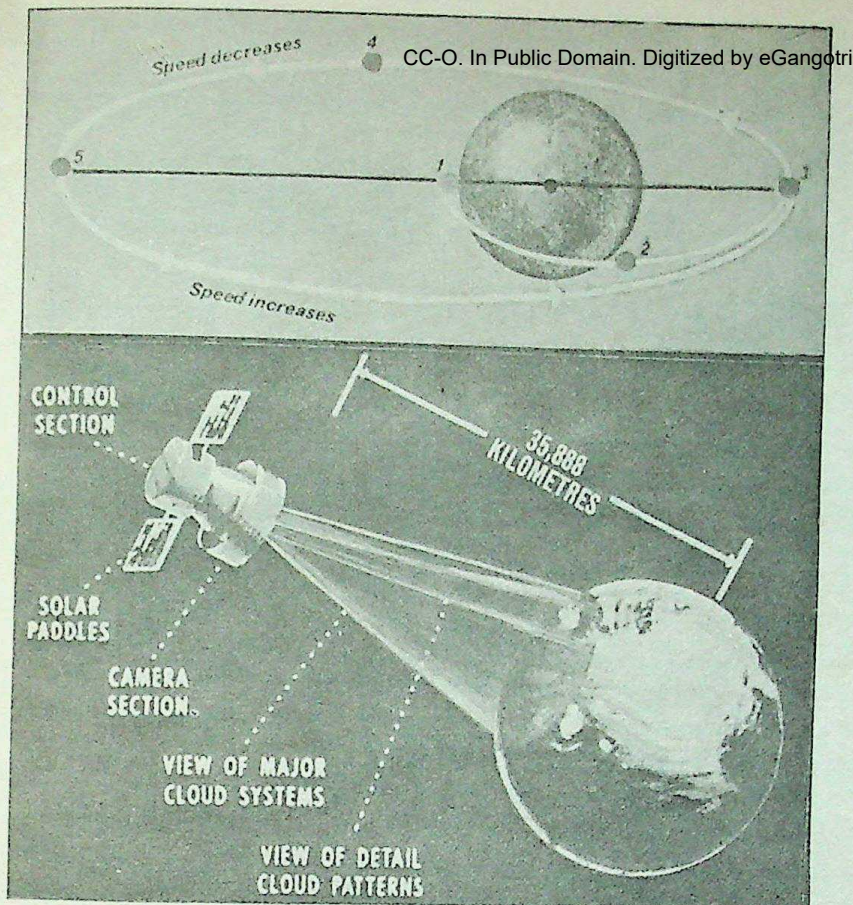
Some forms of water glass are slightly soluble in water while some are almost insoluble. They are best dissolved in water by heating under pressure. Water glass dissolves more readily in small quantity of water. The solutions are strongly alkaline.

There are several compositions of water glass. Some are colourless while others are white or greyish white. However, all the forms resemble glass.

The water glass is used for cleaning. It is also used to preserve eggs. When eggs are put in a container having water glass solution, it coats the shell with a thin layer thus preventing the entry of bacteria. It is also employed as a protective coating agent on artificial stones for buildings to prevent weathering. It's also used in the manufacture of fireproof cement.

Water glass also serves as a bonding agent in the manufacture of grindstones and abrasive wheels. It is a cement for glass or porcelain, and is used in various industrial and certain printing processes.

Water glass is also used in the preparation of a chemical garden. To make this mix one quarter of water glass to three quarters of warm water. When this is cool, drop coloured solution. Within a few days they will grow into coloured strands that resemble plants. These growths are basically tubes of the metal silicates.



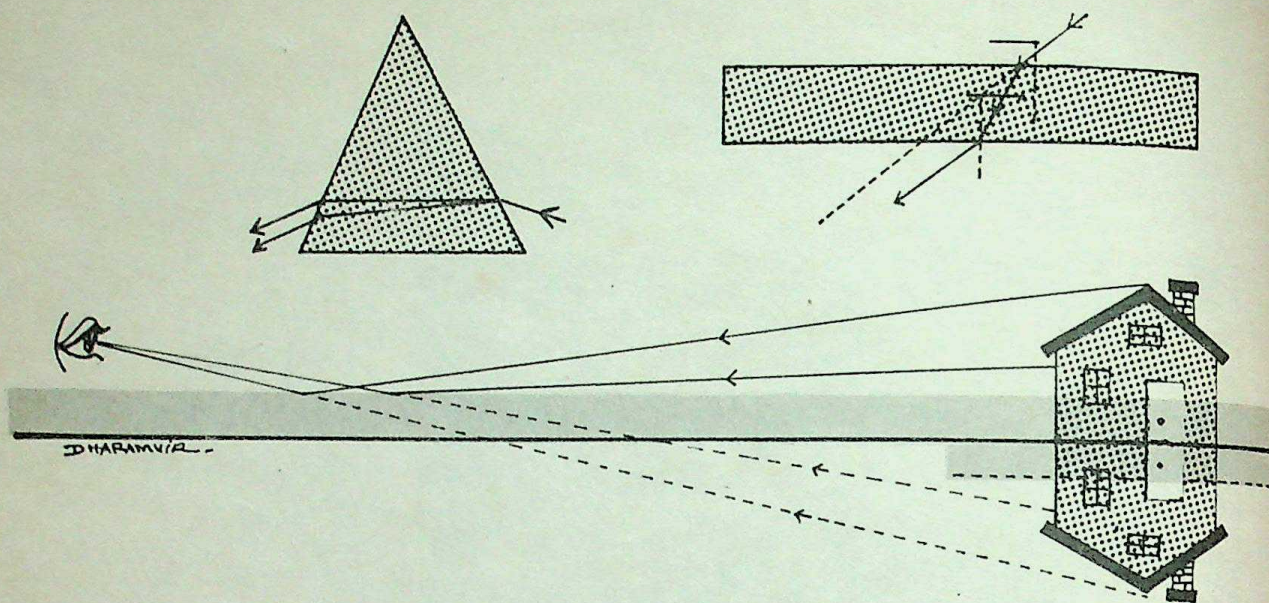
How do
satellites
stay up in
space?

Anything that moves in an orbit in space is called satellite. The moon is a natural satellite of earth because it orbits the earth. All the planets, except Mercury and Venus, have natural satellites.

Today we also have artificial satellites. These 'artificial' satellites are man-made. They are made on the earth and put into the earth's orbit by rockets.

A satellite orbiting the earth is like a chestnut being whirled on the end of a piece of string. The centrifugal force of its motion forces it outwards, but the earth's gravity keeps it from moving away. These two forces balance it and the satellite continues to orbit the earth. It moves without any resistance since there is no air in space. It will keep on orbiting forever, unless it moves near the earth and the upper atmosphere drags on the satellite and slows it down. The satellites move in elliptical orbits rather than circles. The nearest point to earth is called the perigee and the farthest, the apogee.

More than 1500 artificial satellites have been launched since Sputnik I which was the first satellite to be launched by the Soviet Union on October 4, 1957. These satellites are serving many useful purposes today. The communication satellites bounce radio signals from one continent to another, making worldwide TV and telephone services possible. The science satellites measure conditions in space and observe the sun, planets and stars from the space. The weather satellites send back photographs about the earth's weather, making weather forecasting much more accurate. Other satellites aid navigation and air traffic control. The latest earth resources satellites are able to detect the pressure of oil deposits and shoals of fish.

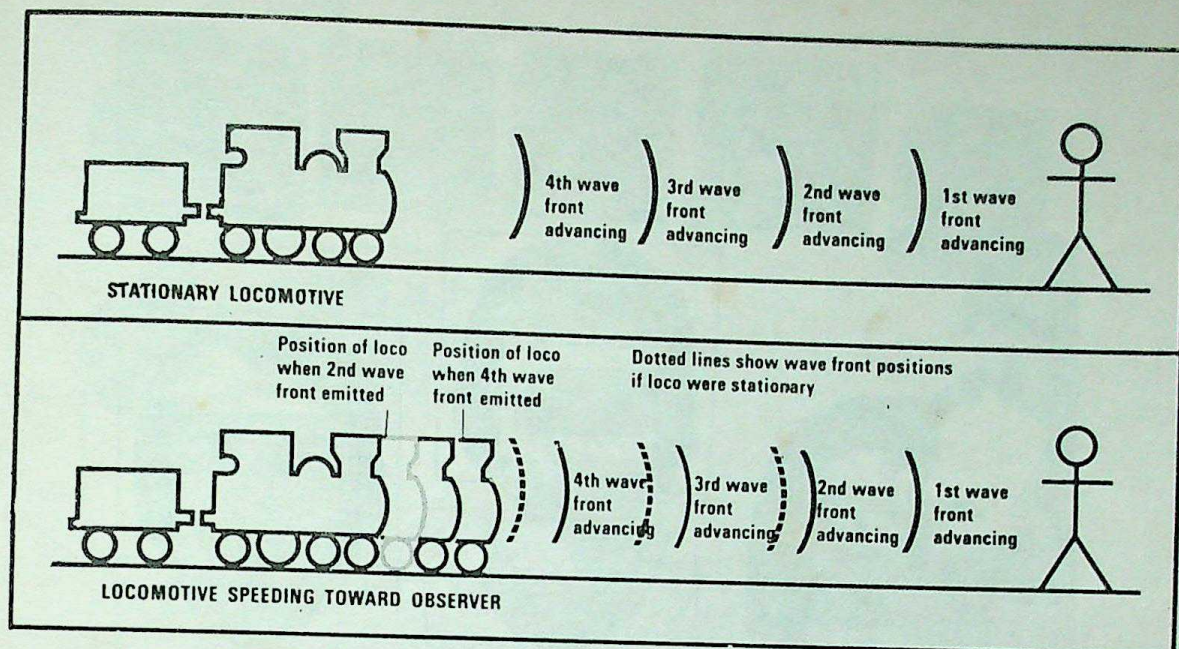


What is refraction of light?

The 'refraction of light' is defined as the change of direction of the ray of light as it passes from one medium to another say air to glass or vice versa. The ray of light can bend either towards or away from the normal. The normal is defined as the perpendicular line to the interface of the two media. When a ray of light passes from air into glass, it bends towards the normal. When it passes out into air again, it bends away from the normal. In other words, when a ray of light passes from rarer to denser medium, it bends towards the normal and when it's the other way round, it bends away from the normal. When a ray passes from one medium into the other its speed also changes. If the ray goes from rarer to denser medium its speed decreases and vice versa.

There are two basic laws of refraction. The ray that hits the surface (incident ray) and the ray that travels in the second medium (refracted ray) and the normal—all lie in the same plane. The second law is called Snell's law. According to this law the ratio of the sine of the angle of incidence to the sine of angle of refraction is constant. The size of the constant depends on the two materials through which the light is passing. It is termed as the refractive index between the two materials.

The phenomenon of refraction gives rise to many interesting effects. For example, when we put a pencil in a glass of water, it appears bent near the water surface due to refraction. A spoon in the glass of water shows the same effect. A coin in the bucket of water appears risen. The mirage in the deserts is also produced by refraction and total internal reflection of light. The twinkling of stars is caused due to the refraction of light beams in the different layers of the atmospheric air.

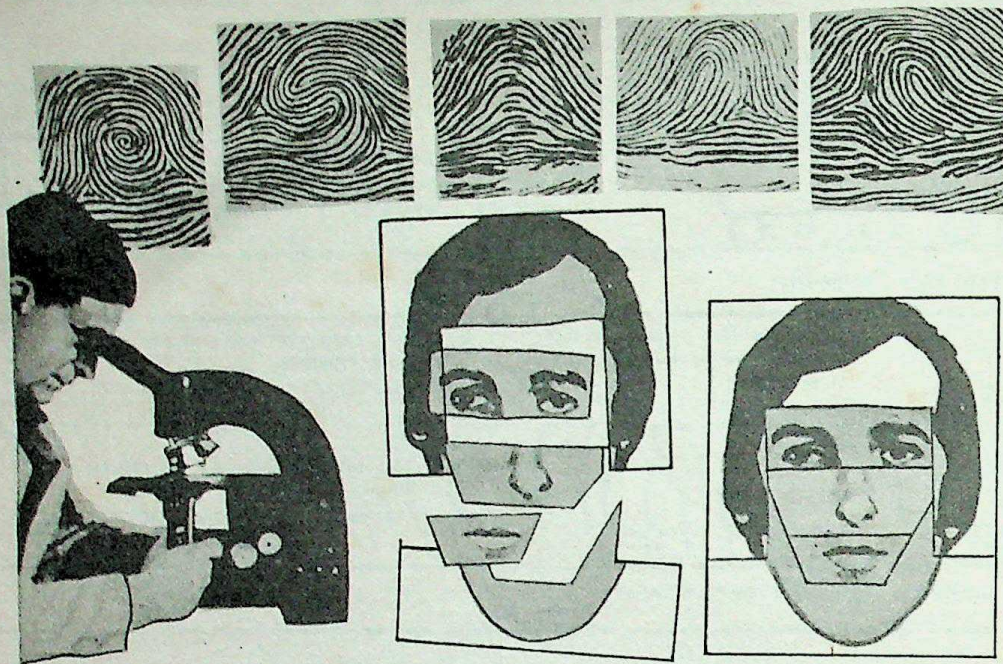


What is Doppler Effect?

The Doppler Effect is described as the apparent change in frequency of sound, light or radio waves caused by the motion of the source, observer or medium. When an approaching train blows its whistle, the whistle's pitch seems higher as the train comes toward you. The pitch seems to lower when the train passes and goes away from you. That's despite the fact that the actual pitch of the sound remains the same. The cause of this effect was first studied in 1842 by an Austrian physicist Christian Doppler.

The basis of the 'Doppler Effect' is the fact that sound travels in the form of waves. The pitch of a sound depends on its frequency. The frequency is the number of sound waves striking the ear every second. When the source of sound is approaching, each wave sent out by the source has a shorter distance to travel than the wave that was sent out earlier. Each wave reaches the listener a little sooner than it would have if the source had not been moving. The waves seem to be more closely spaced. They have a higher frequency or higher pitch. As the train has passed away the observer, each wave starts a little further away. Each wave seems to be longer than it would ordinarily be. The pitch is lowered.

The same thing happens with any other wave motion. The light also travels in wave motion and the Doppler Effect has also been observed where a source of light (e.g. a distant star) is moving. The spectra of stars which travel away from the earth suffer what is known as the red shift (decrease in frequency), while stars which are approaching earth have spectra with a blue shift (increase in frequency). A shift in the pattern of lines observed in the spectrum of a star is useful to the astronomers since it gives an indication both of the direction and of the speed of the star.

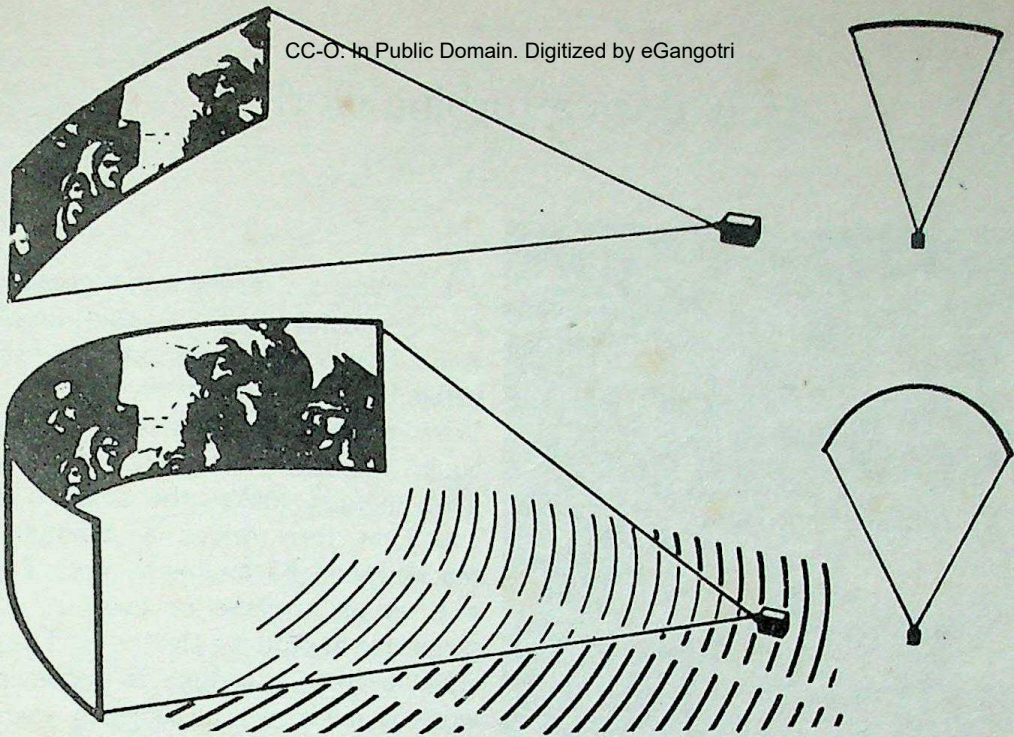


What is the Identikit System?

The 'identikit system' is a system of building up a picture of someone sought by the police. It was developed in the United States in 1960 by Hugh Macdonald. It consists of transparent sheets on which randomly different shapes of faces, eyebrows, noses, mouths and other physical features are randomly drawn. These are interchangeable and can be put together according to witnesses' descriptions, thus presenting in one picture their impressions of a wanted person's appearance. Another system evolved later called photofit uses photographs instead of linear drawings.

Both these systems are based on ideas developed in 1879 by Alphonse Bertillon, a French criminologist. He was the chief of criminal identification department for the Paris Police. His system of identification is known as anthropometry or Bertillonage that came into wide use in France and other countries. This system is based on three basic principles (i) that the precise measurements of certain parts of the body can readily be obtained (ii) these measurements remain constant in a fully grown person and (iii) no two human beings have exactly the same measurements.

Although most of Bertillon's work involved accurate measurements of the body, an important feature was the descriptive portrait. This was a system of sectional photography introduced to replace the haphazard methods of the time. Bertillonage was superseded by the system of fingerprint as the primary method of identification, though it remains an excellent means of furnishing a minutely descriptive portrait valuable to investigators.



What is a cinemascope movie?

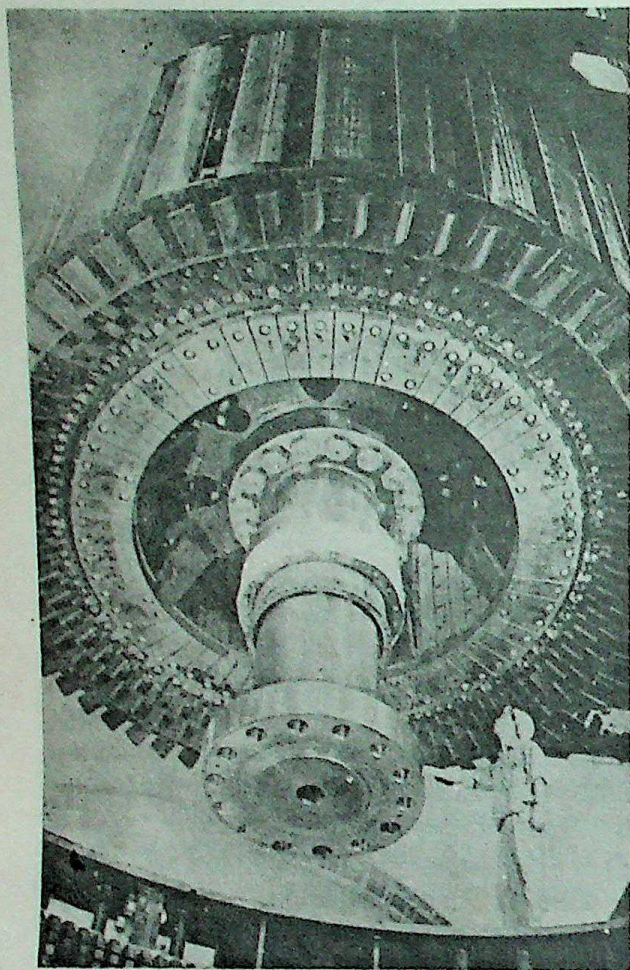
Ever since the advent of motion pictures the scientists have succeeded in developing several techniques to enhance the size and realism of the movies. One of the most popular system is cinemascope. Do you know what is a cinemascope movie?

The cinemascope is a film-making process in which at the time of projection on the screen, the size of the motion picture is increased by two and half times of its height. This technique was invented by the French physicist Henri Chretien in the late 1920s. Here a camera with the help of a special lens called anamorphic lens can 'squeeze' a wide picture onto a standard 35 mm film. Then, by the use of a special projection lens, the image is restored to clarity and expanded onto a wide screen without distorting the proportions.

The invention was ignored until the increasing incursion of television into the film viewing market in the 1940s and 50s forced the industry to find new means of attracting the audiences. The Twentieth Century Fox Film Corporation acquired the rights to cinemascope and introduced it in 1953 in its adaptation of the U.S. author Lloyd C. Douglas' bestseller 'The Robe' (1953). They used a three-track stereophonic sound system along with the wider screen. Other studies subsequently used the same basic technique under names such as Superscope, Warnerscope and Panavision. The cinemascope was the first successful wide screen process.

Today the cinema industry uses five different sizes of films : 70 mm, 35 mm, 16 mm, 9.5 mm and 8 mm. The 70 mm and 35 mm sizes are used by major film companies in cameras that are highly complex and expensive. Both can be used in cinemascope system. The 16 mm film is used for small-budget pictures and documentary films. The 9.5 mm and the 8 mm films are used for low budget television production. Most of the professional movie-makers use negative film—either colour or black and white. The films for projection are always positive but negatives are used for some television transmissions and they are reversed electronically.

How does a turbine work?



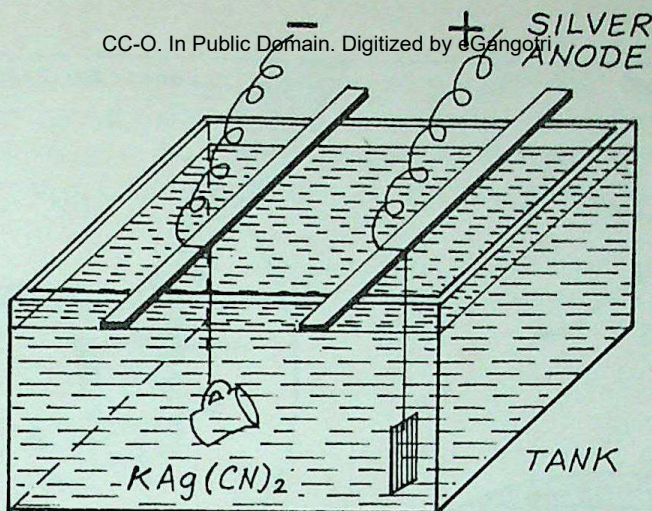
A turbine is a machine that converts the energy of a moving gas or liquid into work. It is made up of a wheel mounted on a shaft. A series of blades are set around the wheel. When these blades are struck by the gas or liquid, the wheel rotates at a fast speed. This, in turn, makes the shaft to rotate, which in turn drives a machine. The machine can be anything—propeller of a ship or an airplane or even an electric generator to produce electricity. The gas or liquid used in a turbine is known as the working medium. The working medium is water, steam or gas.

The water turbines use water from a waterfall or a dam to drive the turbine. There are two different methods to make the turbine wheels rotate. A water jet may be directed onto the blades. This is called an impulse turbine. In the other type the water may flow past the blades. This is called a reaction turbine. In the second method, the turbine wheels are submerged in the flowing water. These turbines are used for generating electricity.

For a steam turbine to operate, the steam must first be produced by heating water in boilers. The steam enters the turbine at a high pressure. Inside the turbine, the pressure drops and the steam expands. This expansion drives the wheels around. Steam turbines have a series of wheels mounted on the same shaft. This is because the steam expands gradually as it moves through the turbine.

Gas turbines use hot gases. These gases are produced by burning liquid fuels or natural gases. Air is drawn into the front of the turbine, and passed through a compressor. The compressed air is mixed with the fuel and the mixture is ignited in the combustion chamber. This produces hot, expanding gases, which drive the turbine wheels.

Gas turbines are used in jet engines. The hot gases are sent out at high speed from the back of the engine. This produces a large amount of thrust which forces the engine to move forward. In jet engines, the purpose of the turbine is to drive the compressor. Turbines are also used in nuclear power stations.



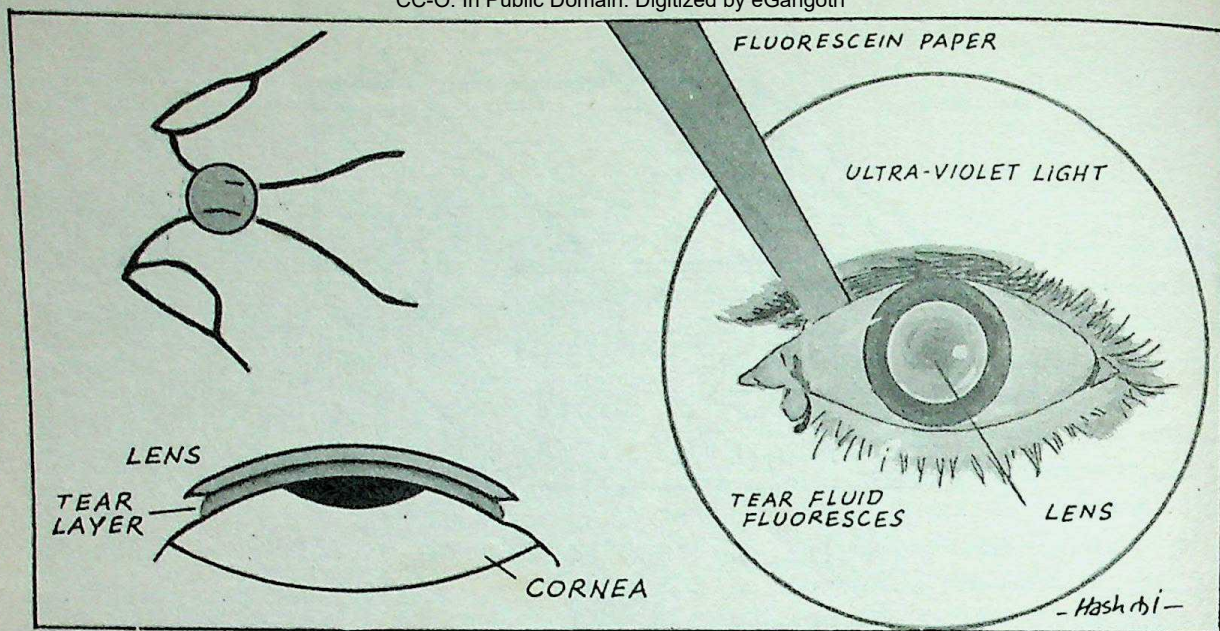
What is electroplating?

Electroplating is a process of metal coating through electrolysis (passing of an electric current through an electrolyte solution). A wide variety of items, ranging from machinery to various household articles are metal plated to protect them against corrosion or to add to their beauty. The electroplating may also be used to impart certain other properties to a metal surface, such as hardness, wear resistance and anti-frictional, electrical, magnetic or optical properties. Do you know how metals are electroplated?

The electroplating is done in large vats containing a solution of some suitable salt of the metal to be deposited. Bars or plates of metal are used as anode, and are arranged inside the vats in such a way as to surround the body that is to be electroplated. This metal body called the work piece makes the cathode. When the electric current is passed through the solution, by connecting the positive terminal of the battery to the anode and negative terminal to the cathode, the metal ions from the solution go towards the cathode and get deposited on the work piece and form a **thin layer** of metal on it. The metal from the anode goes on dissolving in the solution and **finally gets deposited** on the work piece.

To ensure an even deposit, the work piece may be slowly rotated inside the vat. The surface of the work piece must be clean and free from grease, dirt or oxide films. Today there are a number of metals that are electroplated. They include silver, gold, nickel, copper and chromium. For silver plating, double cyanides of potassium and silver are used. The silver plating is usually done on steel tableware such as spoons, forks and other utensils. It is also on ornaments. The Gold baths also contain double cyanides of gold and potassium. This plating is also done on ornaments. The nickel plating baths involve double sulphates of nickel and ammonium. The copper bath contains a solution of copper sulphate with small quantities of sulphuric acid. The chromium plating is done by using the solutions of chromic acid and chromic sulphate with small quantities of chromium carbonate. These metals are usually plated on machine parts.

The other metals which are electroplated commercially include cadmium, cobalt, iridium, palladium, platinum, rhodium, tin, zinc etc. In certain specific cases two or more metals are plated simultaneously in the form of alloy coatings. They include copper-zinc, copper-tin, lead-tin, lead-tin-copper, tin-nickel and nickel-cobalt.



What are the contact lenses?

The contact lenses are worn on the eyeball to aid vision or to correct its defects. All the defects that are corrected by regular eye glasses or others that cannot be corrected thus, can be rectified by contact lenses.

The first contact lenses to be used as eye aid were made by A.E. Fick in 1887. These early lenses were first made by glass-blowing and then by grinding and polishing bottoms of glass test tubes. These lenses were not successful and for a long time remained just a subject of academic study.

However, concrete progress in this direction was made in 1938 when the plastic (methyl methacrylate) contact lenses were developed. From 1938 to 1950 many lenses were made by taking impressions of the eye and forming the lens on this mold. Such lenses had a fluid under them and covered most of the eye. After 1950 smaller lenses were used that covered only the cornea (front surface of the eye) and floated on a layer of tears. In this case it is not necessary to make an impression of the eye as the curvature of the cornea can be measured by optical instruments. Such lenses are usually only 7 to 11 millimeters in diameter and 0.1 to 1 mm in thickness and can be worn all day without removing.

To fit the contact lenses, the eyes are first tested for the vision defects just as they would be in case of spectacles. Then the radius of curvature of the eye surface is found by using a device called keratometer. After deciding the diameter and power of the lens, the prescription goes to the manufacturer for making the lens.

To make the contact lens first the plastic rod is sawn into sections and turned on a lathe to make button-shaped tablets known as bonnets. Then they are given the right curvature with the help of machines for obtaining desired power and finally polished.

The lenses are then examined to see whether they fit the eye well or not. Finally they are worn on the eye lens. With practice these lenses can be worn comfortably by most of the people for 12 hours at a stretch.

Besides being invisible, contact lenses provide a much wider field of vision than the ordinary spectacles. They are more practical in active sports since they are not easily lost or broken, and can even be tinted to protect against the sun. But contact lenses are not effective in all cases of eye trouble. They are also expensive and some people find difficulty in wearing them.

As the research continues, even smaller and more flexible lenses are being developed. In the early 1970s soft lenses of hydroxyethyle-methacrylate were introduced which are less irritating to wear.

What are the different abrasives?

An abrasive is a substance used to grind, wear down, scrape or polish other materials. The two main forms of abrasives are paper and grinding wheels. The abrasive paper is made by coating ordinary paper with a glue and adding the abrasive material to it. The sandpaper, emery paper, and carborundum paper are made in this way. To make a grinding wheel, abrasive material such as quartz, is mixed with clay and water. This mixture is then pressed into desired size and shape and fired in a furnace. The heat makes a strong bond among the materials.

The fineness or coarseness of the particles used in an abrasive material is described in terms of 'grit number'. The abrasive material with a grit number of 60 are much finer than abrasives with a grit number of 30.

The hardness of an abrasive is also an important factor. It is measured on Mohs scale. The Mohs scale ranges from 1 to 10. Abrasive is chosen according to the material to be grinded. It should be harder than the material that's to be polished.

The most widely used abrasives are fused aluminium oxide and silicon carbide. The aluminium oxide is known as alumina. It is used to grind and polish metals like steel, wrought iron and hard bronze. The silicon carbide is known as carborundum. It is made by fusing sand and coke in an electric furnace. Carborundum is used to grind and polish brass, copper, aluminium, stone, glass and ceramics.

Many varieties of quartz are also important abrasives. Pumice is a volcanic rock. When ground to a fine powder, it is used in scouring powder and soaps. Crystalline iron oxide is used to polish jewellery and glass. It is known as rouge because of its red colour.

The synthetic diamonds, diamond powders and diamond pastes are also used as abrasives. They are used to make drill bits and cutting wheels. Tungsten carbide is used in the machine tool industry for drilling, cutting and polishing metals. Boron carbide is another important abrasive. It is valuable because it is almost as hard as diamond.



Which different techniques help police to identify criminals?

The criminals are detected and identified with the help of the forensic science. In fact, forensic science is the application of science and technology to the problems concerning civil and criminal law. The forensic scientists make use of various branches of science including medicine, biology, chemistry, photography and ballistics. They work in close association with the police and other investigative agencies to help establish how and when a particular crime was committed. They analyse the evidence found at the scene of the crime. Often their special investigations lead to the capture of criminals.

One of the most important branches of the forensic science is forensic medicine. It is particularly important in the case of violent death or injury. When a person is suspected of having died from an unnatural cause, a doctor examines the body in detail. He must tell for how long the person has been dead. First of all the doctor calculates this by measuring the body temperature. A doctor knows that a dead body cools at a certain rate under normal conditions. From the formula, he can determine the approximate time of death. But when the body has been dead for a long period of time more complicated methods are used.

The forensic medicalmen also find out the actual cause of death. If the victim died of a stab wound, they are able to figure out the size and shape of the weapon. They can also determine if the wound was made by a knife, hatchet or blunt instrument. In the case of gunshot wounds, doctors work with ballistic experts to determine the caliber or size of the bullet. They are also able to tell the angle of penetration in the body and the distance from which the shot was fired. The bullets are examined under a microscope to find out about the make of the gun used. Most of the guns leave individual marks on the bullets they fire.

The forensic scientists also use many chemical methods. Even tiny fragments of paint embedded in a victim's skin can lead to extract the information about the year, model and

make of the car that struck the person. In case of forgery they analyse paper and ink. Almost invisible trade marks, called watermarks on most paper can lead scientists and detectives to determine where and when the paper was purchased. The ink can be analysed and traced to its source of supply.

Blood stains on clothing and other objects at the scene give a valuable information about the criminal. The forensic scientists determine the blood group. A tiny bit of dust found in a victim's shirt pocket or a bit of mud clinging to a shoe can tell where the crime took place.

The fingerprints give important clues about the criminal. At times the criminals leave their fingerprints on objects such as door knobs or drinking glasses at the scene of the crime. The fingerprint experts sprinkle a fine, white powder on these objects and the fingerprints show up. Since no two persons have similar fingerprints the criminal can be identified with its help.

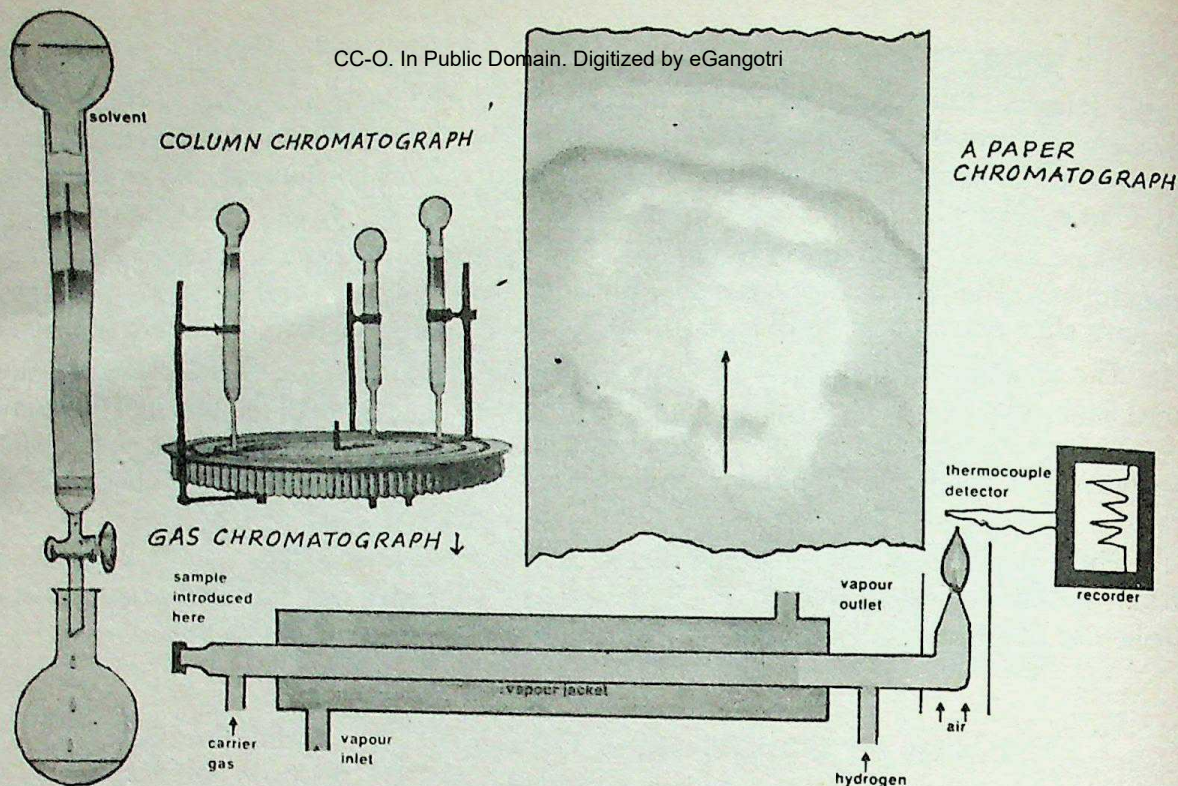
Photography is another method that is used in criminal investigations. A camera can often capture details that are not readily visible to the unaided eye. Forensic scientists also make use of infrared or ultraviolet light and X-rays to examine the evidence.

What is Chromatography?

Chromatography is a sophisticated and useful technique for separation, isolation, purification and identification of the constituents of a mixture. It is based on the general principle of phase distribution. The term chromatography has its origin in two Greek Words 'khromatos' (colour) and 'graphs' (written). It was first used in 1906 by Mickall Tswett, a Russian botanist, to demonstrate the separation of plant pigments into distinctive colour zones. He used a glass column filled with calcium carbonate. Down this column, he passed a plant extract dissolved in petroleum ether to obtain green and yellow bands of the pigments. Although most separations now concern colourless compounds, the original term 'chromatography' has been retained.

Depending upon mobile and stationary phases, there are several forms of chromatography such as paper, thin layer, gas and column chromatography.

The paper chromatography—sometimes called adsorption chromatography—is based upon the fact that porous paper adsorbs different substances to different extremes. The mixture to be studied is first dissolved in a liquid. A small drop of solution is then placed at about 1 cm distance from the edge of paper strip such as filter paper. After the solution dries, the paper, with the sample spot at the bottom, is hung vertically in a glass vessel. In this position, the lower edge of the paper strip makes a contact with a layer of solvent in the vessel. The solvent rises among the fibers of the paper by capillary action. In this process the solvent carries various substances in the sample spot to different heights on the paper strip, thereby separating the substances. The substances which were strongly absorbed by the paper, and



mix only slightly in the solvent, rise only upto a little distance. The substances that were not strongly absorbed by the paper, and dissolve easily in the solvent, are carried to the higher levels. If the substances in the original mixture were coloured, a group of coloured spots can be seen between the position of the sample spot and at the top of the paper strip. Each spot contains one of the substances in the original mixture. The paper strip is now called a chromatogram. It is removed from the glass vessel and dried. Certain substances can often be identified by the heights they reach on the chromatogram.

The substances in each spot can be removed from the paper by treatment with a certain solvent. This process is called elution. Once a solution of the purified substance has been obtained, it can be identified by chemical tests.

Chromatography can also be used to separate and identify mixtures of colourless substances. In order to do this, the chromatogram is sprayed with certain chemicals. The chemicals react with the substances to be studied, producing coloured compounds.

Thin layer chromatography is almost the same process as paper chromatography. In thin layer chromatography, the paper is replaced by a sheet of glass on which a thin layer of adsorbent such as silica gel has been placed.

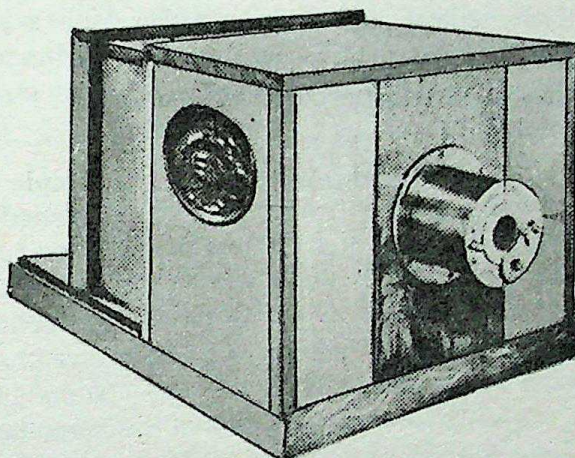
In absorption chromatography as described before, the absorbent material such as paper is called the stationary phase. The solvent is called the moving phase. In partition chromatography, both the moving phase and the stationary phase are liquid.

The gas chromatography is a type of partition chromatography. The stationary phase is a liquid and the moving phase a gas. It is often used to study substances that form vapours such as petroleum products.

In column chromatography a suitable adsorbent like alumina is packed in column and this constitutes stationary phase. The mixture to be separated is taken in a suitable solvent

and the solution is poured on the top of the column of the absorbent. The components are then eluted out by a suitable solvent which acts as a mobile phase. The weakly absorbed component will be eluted more rapidly than a more strongly absorbed component.

The suitability of each method depends on which of the two major applications of chromatographic separation is required. The first is the preparation of pure compounds and the second the analysis of mixtures. One purpose of analysis may be simply to check the purity of the compound; second to attempt to identify compounds in the mixture, or to obtain at least some idea of their molecular structure; and third, to obtain a quantitative analysis of one or more of the components present.



What is a daguerreotype?

A daguerreotype is a photograph taken through a special process in which the impression is taken on a silver plate sensitised by iodine and then developed by vapour of mercury.

The type of photography has been named after Louis Jacques Mande Daguerre of France. He invented this technique in collaboration with Joseph Nicéphore Niépce in the 1830's. Daguerre and Niépce found that if a copper plate coated with silver iodide was first exposed to light then fumed with mercury vapour, and finally fixed by a common salt solution, a permanent image would be formed. The Daguerreotype process was announced at a meeting of the Academy of Science by the eminent astronomer and physicist D.F.J. Arago.

A great number of daguerreotypes, especially portraits, were made in the mid-19th century. In 1822, Daguerre opened at Paris the Diorama, an exhibition of pictorial views. Here various effects were induced by changes in the lighting. A similar establishment was opened in Regent's Park London but was destroyed by fire on March 3, 1839.

Daguerre, in the recognition of his work, was appointed an officer of the Legion of Honour. In 1839, Daguerre and heir of Niepce (Niepce died in 1833) were assigned annuities of Fr. 6000 and Fr. 4000 respectively in return for their immense contribution in the field of photography.

How do we measure the hardness of materials?

Hardness is a characteristic property of the solid objects. It is measured by the resistance which the body offers to everything which tends to scratch it. The hardness of the various materials is measured either on the 'Mohs' scale, or the 'Knoop' scale.

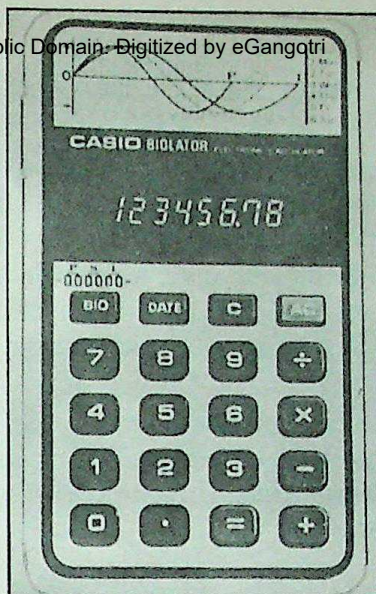
The Mohs scale, first devised in 1822 by Friedrich Mohs, measures resistance to indentation as judged by the material that will scratch another. Mohs scale is numbered from 1 to 10 i.e. it gives 10 grades of hardness. In this scale diamond is the hardest material and talc is the softest. Diamond has a hardness of 10 Mohs and talc has a hardness of 1 Mohs. The Mohs scale is as follows:

Mineral	Hardness in Mohs.	Simple hardness test.
1. Talc	1	crushed by a fingernail
2. Gypsum, rocksalt	2	scratched by a fingernail
3. Calcite	3	scratched by a copper coin
4. Fluorite	4	scratched by glass
5. Apatite	5	scratched by a Penknife
6. Feldspar	6	scratched by quartz
7. Quartz	7	scratched by a steel knife
8. Topaz	8	scratched by corundum
9. Corundum, sapphire	9	scratched by diamond
10. Diamond	10	hardest substance

Mohs scale which assigns numbers to natural minerals, has been widely accepted and is used by mineralogists. This test, however, is not quantitative. For example, the hardness of sapphire is 9 on the Mohs scale, it does not mean that sapphire is 10% softer than diamond.

The mineralogists carry a box containing pieces of the above minerals for testing samples in the field. For example, if they find a mineral that is scratched by feldspar but not by apatite, its hardness lies between 5 and 6 on the hardness scale.

The Knoop hardness test employs an elongated diamond-shaped indenting device, and measures the indentation it makes in a given test material. With the Knoop test, the hardness of extremely brittle materials including glass and even diamond can be measured without damaging either the indenter or the test piece. The size of the indentation is taken as a measure of the material's hardness.



What are the different types of calculators?

A calculator is a device that can do arithmetic calculations with accuracy and speed. They are mainly of two types: (I) mechanical and (II) electronic. Do you know how these calculators work?

In mechanical calculators moving wheels and gears are used. The first calculator was, the abacus, which used moving beads on rods. This device was in use for centuries before Blaise Pascal developed a primitive adding machine in 1642. In the nineteenth century Charles Babbage developed a calculator which was the forerunner of the computer. The first practical adding machine was patented in 1888 by an American inventor, William Burroughs. This led to the development of many different types of calculators in the following years. Since they all involved moving parts they were slow and tended to breakdown, or develop faults after heavy use. Though mechanical calculators are still in use, they are no longer manufactured.

The electronic calculators use miniature electronic circuits to perform basic arithmetic calculations. However, apart from the elementary arithmetic like addition, subtraction, multiplication and division many of those calculators can also be used for complex calculations involving trigonometry and calculus.

The first electronic calculator, based on computer circuit technology, was the "Bell Punch Anita machine" devised in Britain in 1963. It used thousands of discrete transistors in its circuitry. It marked the end of the mechanical calculators.

With the introduction of integrated circuits by Fairchild and Texas Instruments in the early 1960's the success of the electronic calculator was assured. An integrated circuit contains the equivalent of many thousands of transistors and their associated components, and is built up from a single chip of silicon as small as 0.3 cm square. The first compact calculator, based on an integrated circuit and using light emitting diode (led) read out display was introduced by the Bowmar Corporation as recently as 1971, and since then calculator production has expanded enormously with a corresponding drop in prices.

The operation of a calculator is regulated by a clock circuit which, as its name implies, generates timing pulses that are used to synchronize the operations of other sections of the

machine. In a simple calculator, the clock may operate at a rate of about 250,000 pulses per sec. Which would enable it to perform 250,000 operations in one second.

The calculators use a form of binary arithmetic to perform their calculations, being based on the number 2, all binary numbers can be represented by combinations of 'is' and 'os'. In a calculator a '1' is present when a circuit is on and a '0' when it is off.

The form of binary arithmetic used by calculators is known as binary-coded decimal (BCD), and the calculator contains an encoder which translates the decimal information from the key-board into BCD, and a decoder which translates the BCD into decimal form to derive the output display.

Some calculators have electronic memories for storing information. Some calculators can be programmed to perform certain operations automatically, Electronic calculators are extremely accurate and easy to use. They are available in convenient sizes with many different features.

What is a crystal?

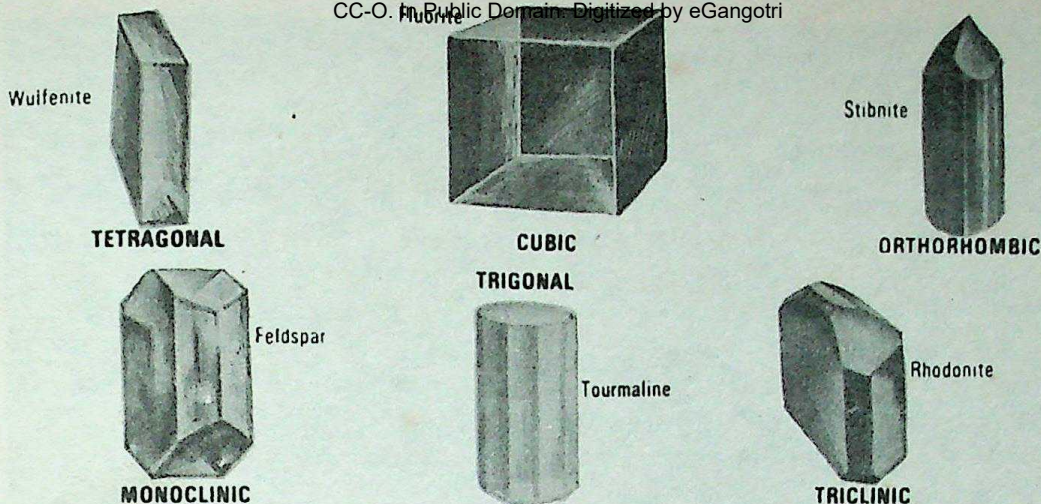
A crystal is a solid substance with a definite geometric shape. Most substances such as salt or sugar can grow into definite shapes. The shapes consist of smooth, flat surfaces that meet in sharp edges and corners. The process by which such substances grow into these shapes is called crystallization. Substances that do not form crystals are called amorphous substances. Glass is an example of emorphous substances.

Crystals owe their shapes to the ways in which their atoms are put together. The surfaces of a crystal are flat and smooth because the atoms are arranged in a definite pattern in layers upon layers throughout the crystal. The pattern upon which layers of atoms attach themselves to the crystal is called a lattice. Crystal structures are mainly studied with the help of X-rays.

Crystals are grouped into various types by the geometry of the flat surfaces and the angles at which the adjoining flat surfaces meet. For every crystal lattice it is possible to select a group of lattice points which sets the pattern for the whole lattice. This three-dimensional group of points is called the unit cell of the crystal and it is characterized by the distances, a , b and c along three edges of the unit cell and the angles α (alpha), β (beta) and γ (gamma) between pairs of edges (b, c), (c, a) and (a, b). On this basis the crystals have been grouped into seven systems. These are (i) cubic, (ii) tetragonal (iii) orthorhombic (iv) Monoclinic (v) Triclinic (vi) hexagonal and (vii) Rhombohedral.

Cubic system has a cube in its simplest form i.e. cubic crystals have three axes of equal length, all at right angles to each other. In such crystals $a=b=c$ and $\alpha=\beta=\gamma=90^\circ$. Gold, copper, zinc etc form in such crystals. Cubic crystals are of three types (a) simple cubic (b) body centred cubic and (c) face centred cubic.

In the tetragonal system, the simplest form is a prism in which the sides are rectangles, and the top and bottom are squares i.e. $a=b \neq c$ and $\alpha=\beta=\gamma=90^\circ$. Tetragonal crystals have three



axes at right angles. One of the axes is shorter than the other two, which are equal. Rutile crystallizes as tetragonal system.

In the orthorhombic system, the crystals also have three axes at right angles but the axes are all of different lengths i.e. $a \neq b \neq c$ but $L=B=r=90^\circ$. Topaz has such crystals.

The monoclinic system has three axes, all of different lengths. Two of these axes are not at right angles to each other i.e. $a \neq b \neq c$ and $L=r=90^\circ$ but $B \neq 90^\circ$. Borax crystallizes in this system.

The triclinic system has three unequal axes. None of these axes are at right angles i.e. $a \neq b \neq c$ and $L \neq p \neq r \neq 90^\circ$. Potassium dichromate crystallizes in this system.

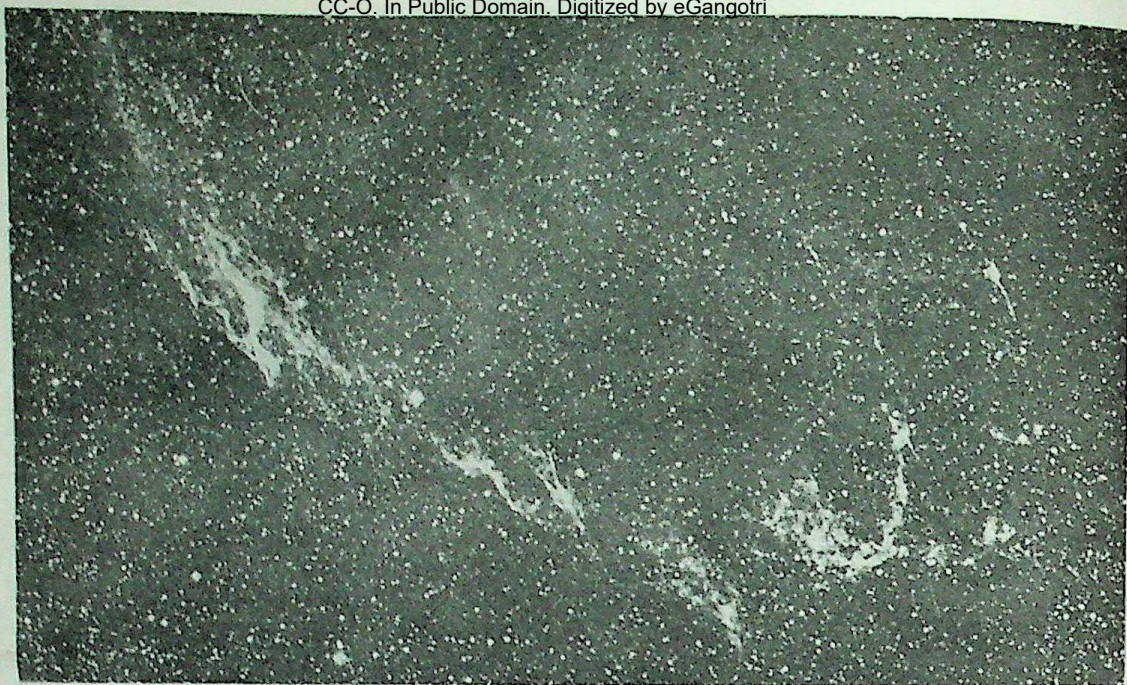
In the hexagonal system, a crystal consists of six sides, instead of four as in the other systems. In these crystals $a=b \neq c$, $L=B=90^\circ$ and $r=120^\circ$. The system includes beryl crystals.

In Rhombohedral system three axes are equal, three angles are equal but none is 90° i.e. $a=b=c$, $L=B=r \neq 90^\circ$. Calcite falls in this system.

Crystals are very useful for us. Quartz crystals are used in watches, hearing aids and microphones. Quartz crystals are also used in oscillators. Sodium chloride crystals are used in infrared spectrophotometers. Transistors are crystals of semi-conductors and have electrical properties that depend on the arrangement of atoms in the crystal lattice.

What are Nova and Supernova?

Some stars that have been shining steadily for millions of years suddenly undergo a fantastic change. Within a few hours or day their brightness increases 100,000 times or more. An ordinary observer might think that a new bright star has appeared in the sky. Such increase in brightness occurs when an explosion throws up a small amount—probably less than a hundred thousandth of a star's matter. This matter is actually a shell of gas that expands brilliantly in the outer space. A nova reaches its maximum brilliance in a few hours or a few



days, and then fades gradually back to its normal brightness. However, the astronomers are not sure what exactly causes a nova.

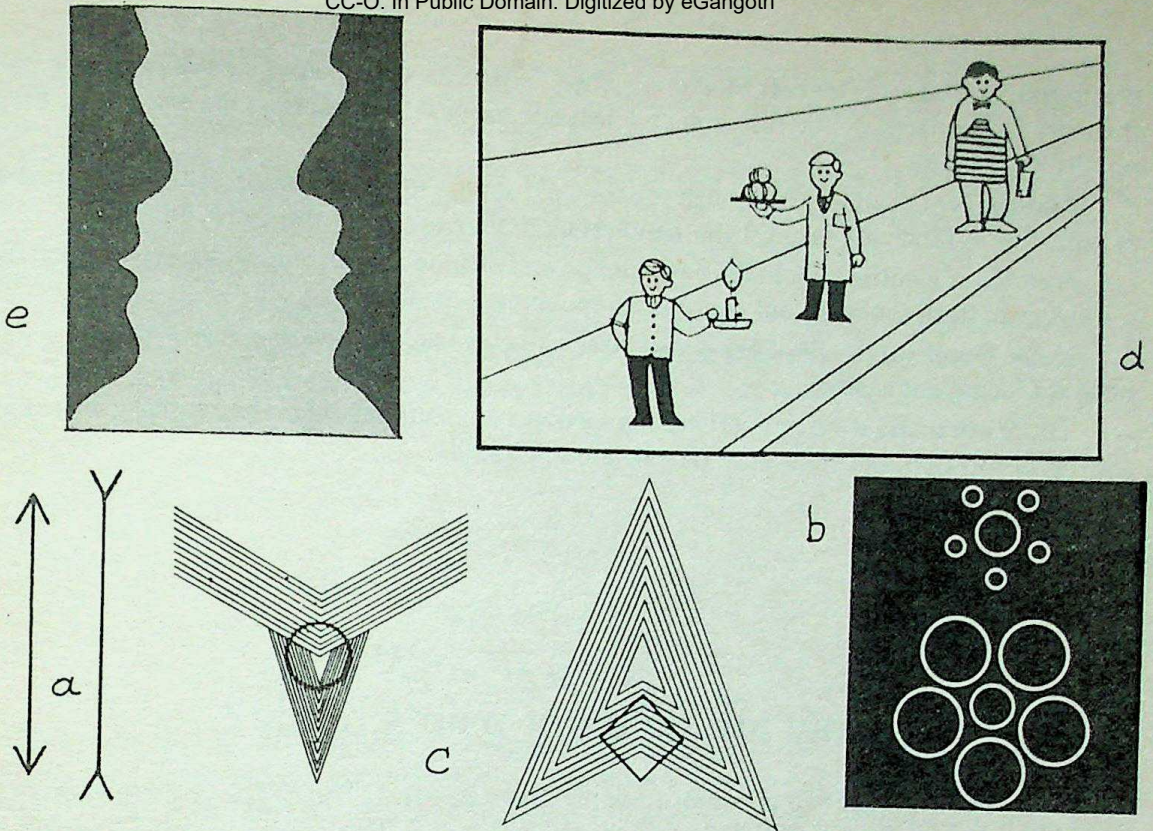
About 20 or 30 novae are believed to occur in our galaxy every year. Some novae have been known to erupt more than once and are termed recurrent. All recurrent novae flare up at long intervals. About five recurrent novae are known to exist in our galaxy.

It has been found that the novae reach absolute visual luminosities 10,000 to 1,000,000 times than that of the sun. The total energy emitted during a large nova outburst is of the order of 10^{45} ergs, equal to the radiation from the sun in 10,000 years. Should the sun become a nova, the earth would be destroyed in a few hours or days. However, sun is unlikely to become so.

After achieving the maximum brightness, the brightness of an ordinary novae may decline at various rates, and it often fluctuates. After a few years the brightness of the nova remnant usually becomes steady again. A gas cloud may some time be observed around it, expanding at hundreds of kilometres per second.

A supernova is a much more spectacular event than a nova. A star may throw off one-tenth of its matter in a supernova explosion. This may result in a billion times increase in brightness.

In 1054, a supernova occurred in Taurus that was bright enough to be seen during the day. The remains of this explosion we see today as the crab nebula which has become one of the most fascinating objects in the heavens. In 1572 Tycho Brahe observed a supernova which was visible in broad daylight. So did Johannes Kepler in 1604. This was the last time a supernova appeared in our galaxy. In general supernova seem to occur in a galaxy about once in 300 years. Other galaxies have similar rate of nova and supernova occurrence.



What is an optical illusion?

An optical illusion is described as an erroneous perception of reality. This is basically the result of misinterpretation by brain of information received by the senses.

The optical illusions are quite normal phenomena. They are experienced by every normal person at one time or the other. The experiments have shown that even some animals experience them. Even pigeons and fish can be misled by appearances.

The best known optical illusions concern size and shape. However, the position, colour and movement can also be misleading. Here we present some examples of optical illusions.

In the Mullerlyer arrow illusion, the vertical lines are actually of the same length (fig-a). However, the line with the arrow-heads pointing outwards appear longer than the line with the arrow heads pointing inwards.

In the 'circle illusion' (fig-b), the circle surrounded by smaller circles looks larger than the one surrounded by larger ones, but both are of the same size. The eye is deceived by the relative sizes of the outside circles.

The illusions of shape occur when lines or circles are drawn on the strong-pattern backgrounds. A circle or square can be made to appear distorted by placing it on a background with a clear, regular pattern (see fig-c).

The illusions of movement may occur when the eye is misled by a series of events taking place one after another. If you look at a strip of cine-film you will see that there are many small

photographs closely attached to one another. When all these separate photographs pass through the projector, they run at such a fast speed that on the screen we see only a single picture (see fig-d).

If you look at the figure (d), the butcher would appear the tallest among all but, as a matter of fact, the butcher, baker and the candlestick-maker are all of the same height.

A series of electric light bulbs switched on and off in sequence can be made to appear like a moving pattern while in fact there is no movement at all.

In the figure (e) the dark areas can be seen as the background to a vase shape or as two persons facing each other.

There are many such optical illusions we observe in our daily life. They can also be a great source of fun and amusement in parties among friends.

How are different paints made?

The paint is a mixture of one or more coloured powders and a liquid. The coloured powder is called a pigment. The liquid is called a 'vehicle' or 'binder'. The 'vehicle' carries the pigment and allows it to be spread over the surface. Many vehicles contain a solvent or thinner.

There are basically two types of pigments—prime and inert. Prime pigments give paint its colour, and inert pigments like calcium carbonate, clay, mica or talc make the paint last longer.

Vehicles include oils, varnishes, latex and various types of resins. When a vehicle comes in contact with the air, it dries and hardens. This makes the pigment bind with the surface.

Types of paints :

There are various types of paints in common use today. The paints often used on walls and floors are oil-based. Such paints serve to protect wood and metals. Latex paints include wall paints and masonry paints. Many masonry paints are produced with substances like polyvinyl acetate or acrylic emulsions. Lacquers are often used to paint the automobiles. It is made up of a solution of resins in a solvent. The solvent dries up after the laquer is put on. Now we also have fire-retardant paints that protect against fire damage. Heat resisting paints are used to cover warm and hot surfaces.

Then there are cement water paints that add colour to cement surfaces, such as a basement floor. In the metallic paints aluminium or bronze powder is used as an ingredient. Enamel paints contain small amounts of prime pigments. They are often used in bathrooms and kitchens.

Manufacture of paints :

For making a paint, a small amount of the vehicle is put into a large mechanical mixer at the paint factory. Then powdered pigment is slowly-added to the vehicle. Thus a heavy paste

is made. Now the paste is put into a grinder to breakup the pigment particles, and scatter them throughout the vehicle. This operation is followed by 'thinning' and 'drying'. Now, the paint is poured until the solution is thin enough for use. Tinting is the next process. A tinter adds a small amount of pigment to give the paint the exact colour and shade desired. The final steps include straining and packaging. The paint is strained through a filter to remove any solid bits, dust or dirt. It is then poured into a filling tank, and finally into the metal cans in which it is sold.

Application of paints :

To obtain a proper finish several layers of paint are applied. The first coat prepares the surface for the other layers. The second coat is heavily charged with pigment and is not glossy. The finishing layer is sometimes glossy. It's application, however, depends upon the type of job handled.

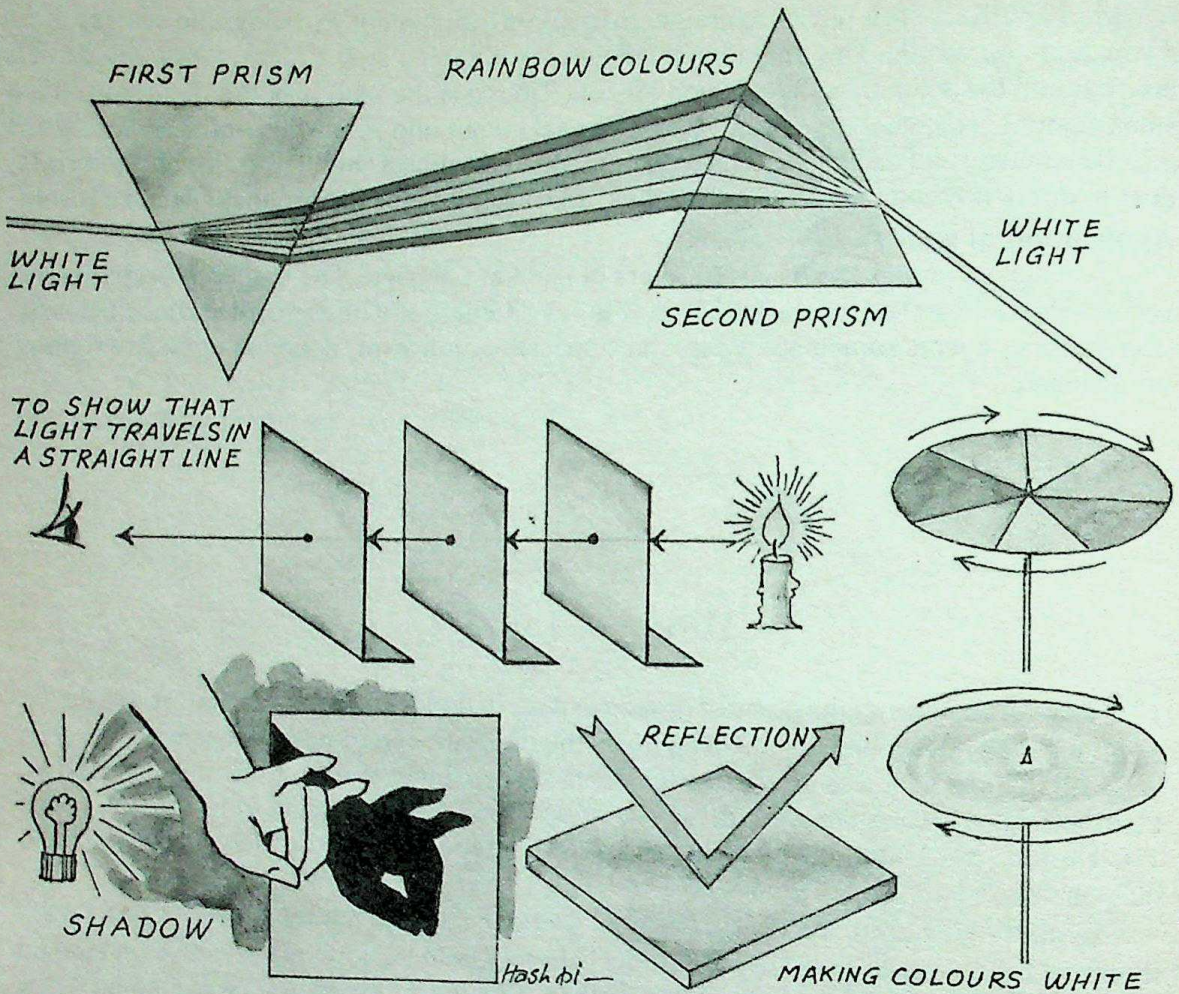
What is Light ?

For thousands of years the scientist groped in dark to understand the true nature of light. To begin with they described it something that's the opposite of darkness. The ancient Greeks believed that the light was rays of matter given out by whatever object was being looked at. Plato and his followers believed that it was a mixture of matter coming from the sun. In the 11th century, the Arabic scientist Alhazen was the first to propound the theory that light could be given out by all luminous objects.

In the 17th century, the British Scientist Sir Isaac Newton put forward the corpuscular theory of light. According to this theory the light travels in the form of corpuscles in straight lines through an imaginary medium called ether. This theory could not explain some of the observed phenomena such as interference and diffraction. In an attempt to explain these phenomena, Christian Huggens of Holland proposed the wave theory of light. He maintained that light was vibrations at right angles to the direction of propagation. It travelled in the form of waves. The waves spread at great speed and in straight lines. He continued that they moved in the ether. The ether was believed to be an invisible substance that was omnipresent. This classical wave theory existed for hundred years. Although it explained the phenomenon of reflection, refraction, interference and diffraction of light, it could not explain the transverse nature of light.

In order to explain the transverse nature of light, James Clark Maxwell developed electromagnetic wave theory. According to this theory the light travels in the form of electromagnetic waves, both electric and magnetic fields are perpendicular to each other and also perpendicular to the direction of propagation i.e. they are transverse electromagnetic waves. This theory explained all the observed facts of light but was unable to explain the photoelectric effect.

To explain the photoelectric effect, Max Planck put forth the quantum theory of light in 1900. He suggested that light is given off in the form of photons. These photons are the

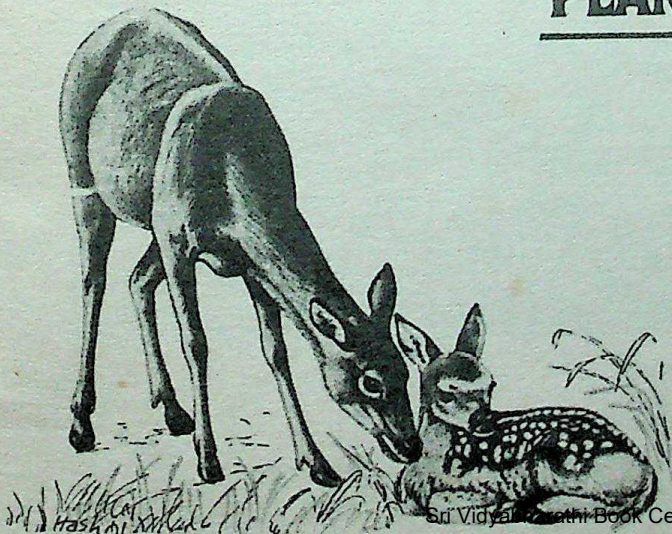


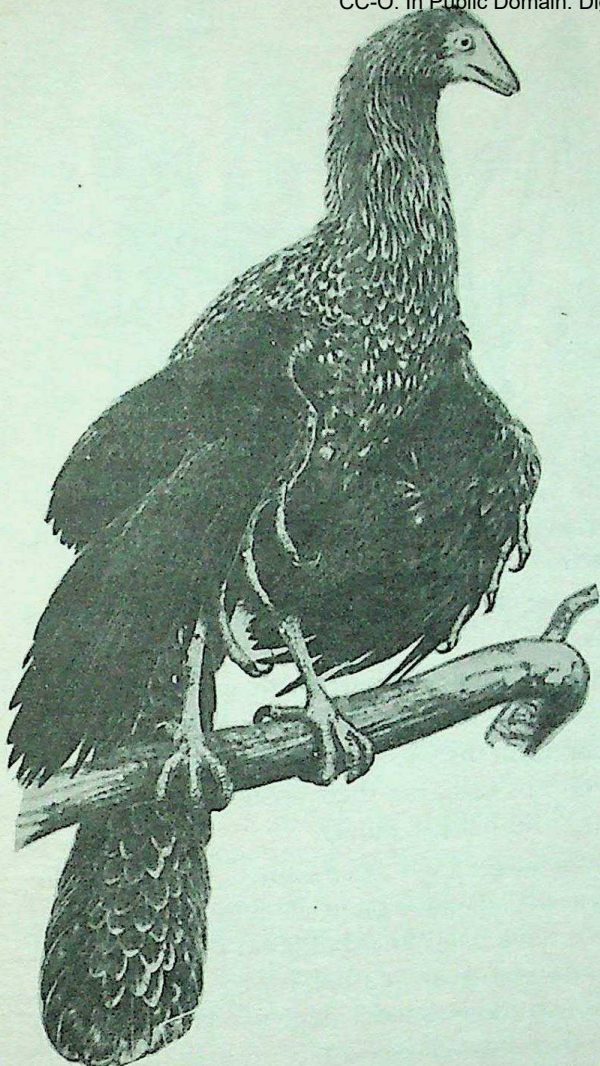
packets of light energy that behave both as particles and waves. All electromagnetic radiations are given out in the form of photons. This packet of light energy was called quantum. The quanta behave both like particles and waves of energy. When the quanta of sufficient energy fall on certain substances, they give off electrons from their atoms. This is called photoelectric effect i.e. production of electricity by light.

Today almost all the physical phenomena of optics are explained on the basis of quantum theory of light i.e. light is made up of waves and particles both.



PLANTS AND ANIMALS





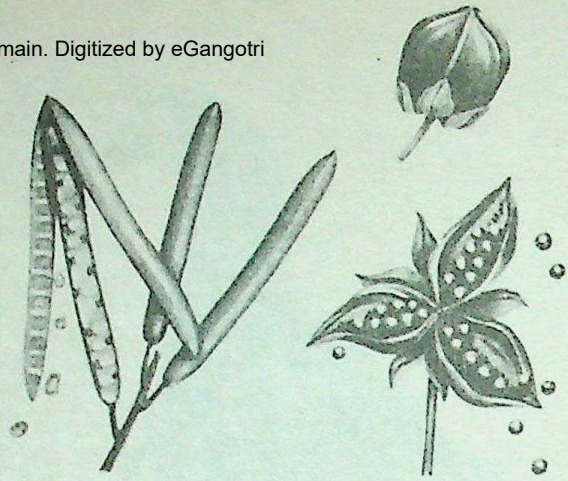
Which was the first bird in the world?

The first bird to exist on the earth was called archaeopteryx. It lived about 140 million years ago. Evolved from reptiles it was quite like a reptile in appearance. Unlike modern birds, it has teeth and a long bony tail. Its head was balanced upon a long thin and probably very flexible neck. It had feathers instead of scales. This was the reason why it was called a bird and not a reptile.

Archaeopteryx's wings were like that of a modern bird with bones inside the feathers outside. But unlike the present-day birds, it couldn't fly very efficiently. That's because it could not flap its wings very hard and probably used them for gliding and sailing through the air. It was a warm-blooded bird.

In this regard two schools of thought have emerged to account for the origin of flight and development of such intermediate forms of creatures. One school holds that the first creature to develop flight were tree-dwelling reptiles that jumped from branch to branch or from trees to grounds in order to escape from enemies or in pursuit of food. The wings developed as a mechanism to aid in gliding or to help ease the fall as seen in the modern flying squirrels. The second hypothesis views the ancestral reptiles as being ground-dwelling forms, lightly constructed and relying mainly upon speed for protection. The development of feather arms and tail aided in lessening forward wind resistance and supplied, initially, lift that increased their speed.

How are the plant seeds dispersed?



Although the plants are also living beings, unlike animals they can't move around and have to remain fixed at one place. It's interesting to note that these fixed plants have evolved special structures for spreading their spores or seeds. This process is called dispersion of seeds. Do you know how the seeds of plants get dispersed?

There are mainly four agents responsible for the dispersion of seeds: the plants themselves (dehiscence); air, water and animals.

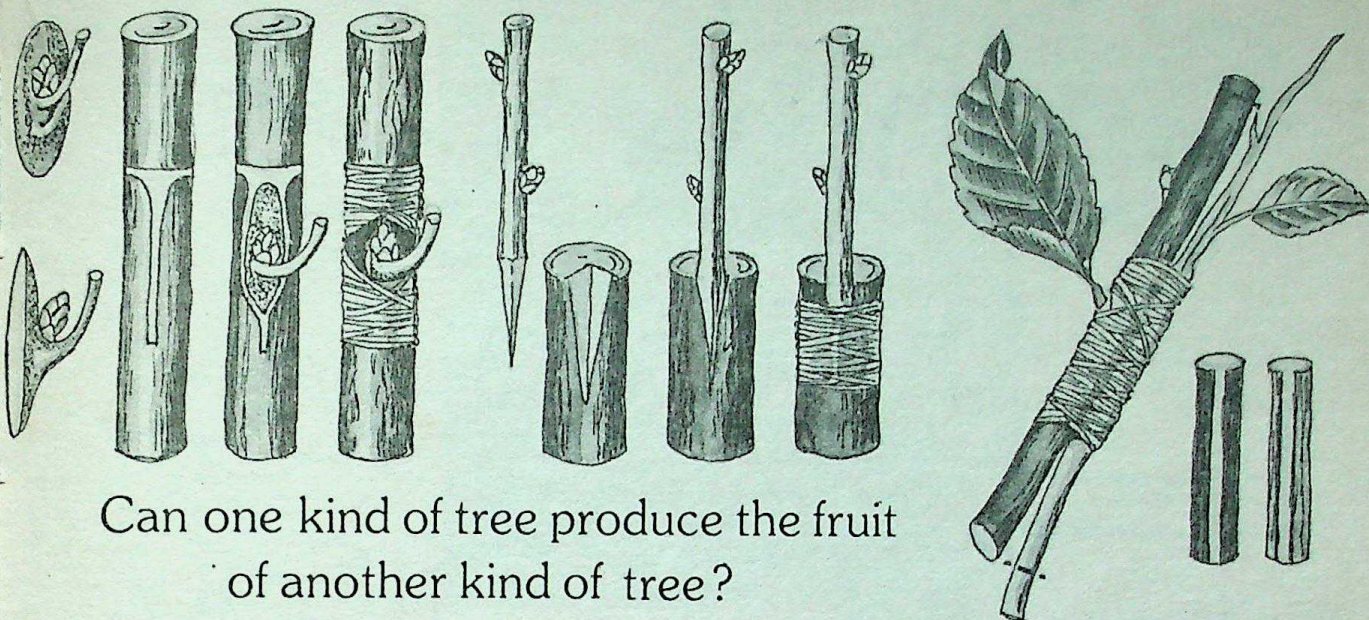
In dehiscence or dispersion by explosion; a seed-containing structure, such as a pod—bursts, shooting the seeds into the air. Such seeds may land up a few centimetres or many kilometres away from the parent plant. This depends on the weight of the seed and the force with which they are thrown. Some of the plants that disperse their seeds in this manner include plants of the pea family (Violets) mustard and balsam family.

Air is also an effective dispersing agent for the seeds. Lightweight seeds, alongwith the wind, travel from one place to another. Some grass seeds have been detected at heights of more than 1000 metres. Lightweight orchid seeds have been found at great distances from their parent plants. Seeds of some plants such as dandelion and cattail, have puffy hairs that help them float through the air. Theseeds of maple, ash and box elder have winglike structure so the seeds act like small helicopters in the wind and get dispersed.

Water is another effective agent and carries seeds alongwith it from one place to another. For dispersion by water, the seeds must be waterproof and able to float. Mangroves and coconuts have floating seeds with tough coats.

For dispersion by animals, plants have evolved many structures. Some seeds have 'burs' or hooks which get attached to clothing or fur or with the tails of the animals. They can be carried to great distances before falling off. Some seeds, such as mistletoe, are enclosed in sticky berries. When a bird or animal eats these berries, the seeds get stuck to its feet, mouth or body. Some seeds are enclosed in juicy, tasty fruits which are attractive to birds, animals, and human beings. These fruits are consumed with seeds, but the seeds are not affected by the digestive system. The seeds are then passed out of the body in the faeces. The seeds of grape, mulberry, pear etc. are dispersed this way. The clover and cereal crop seeds are often dispersed by grazing animals such as cattle and sheep.

Human beings often disperse seeds by throwing away apple cores, peach pits and other inedible seeds from juicy fruits. People frequently and unknowingly carry seeds to great distances by airplanes, automobiles or boats.



Can one kind of tree produce the fruit of another kind of tree?

Reply to this question is, "yes". Many trees can produce the fruit of another kind of tree by the simple method of 'grafting'. The grafting is a technique of attaching the part of one plant to another. If a bud from a twig of pear tree is carefully inserted in slit made in the bark of a quince bush, a pear twig will grow. The quince bush will bear both pears and quinces.

In the same way, an almond tree can be made to produce both peaches and almonds. Although sometimes grafting is used to produce freak trees and bushes, this technique is of immense importance in agriculture.

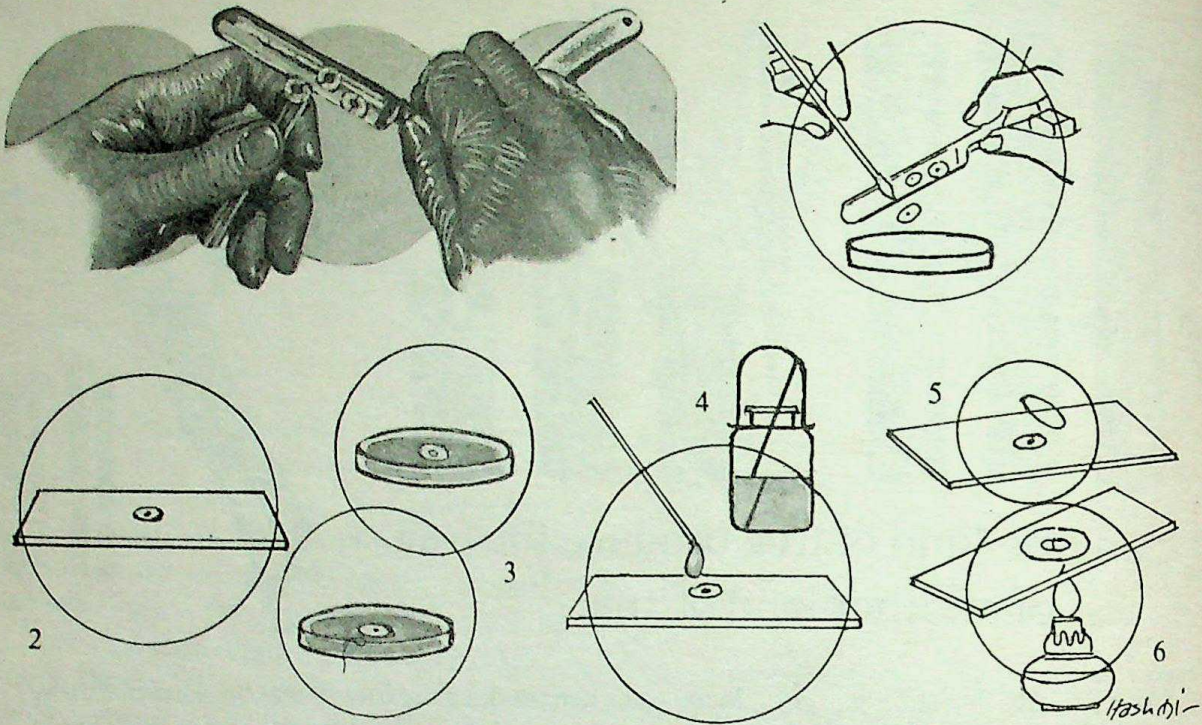
The greatest advantage of grafting is that it can be used to better the quality of particular product. It is possible for a nurseryman or gardener to be sure that his young trees or shrubs will bear the same quality and variety of fruit as the parent tree. A twig taken from a tree and grafted into another tree will produce the same type of fruit borne by the tree from which it was taken.

There are many methods of inserting the budded twigs or scions, as they are called, into the stock of the other plant, but two rules must always be followed: first, only related species of trees or shrubs can be grafted. This means that apples can be grafted on to pear and quince trees and peaches can be grafted onto apricot, almond, plum or other stone fruit trees. It is impossible to graft apples on peach tree.

The second rule is that the cambium layer which carries the vital sap of the scion must touch the cambium layer of the stock on which it is grafted. Otherwise the grafted twig cannot grow.

There are many different techniques of grafting. It can range from inserting a single bud under the bark to grafting long twigs across the wound of a tree in order to heal wide wounds in the bark.

Interestingly enough this unique technique of grafting is being applied to animals too. There have been surgical operations in which a bone taken from the ribs has actually been grafted onto the nasal bone to form a new nose. In some other experiments the healthy skin from one part of the body has been grafted onto the burnt tissue to remove scars.



How do we study internal structure of plants?

The botanists study the internal structure of the plants mainly by examining their cross section under the microscope. These thin slices can tell us a lot about the structure of the cells that make up the plant and how they vary in different parts of the plant. The equipment needed for obtaining the sections includes a sharp razor like one shown in the figure here, a small fine brush and a number of watch glasses and microscope slides. When dealing with delicate material (especially leaves) pieces of pith (that from elder twigs is ideal) are useful for holding the material. The pith and the specimen are held as shown here and the razor is stroked across the top towards the body, cutting off the thin slices required. Cross-sections and lengthwise ones are obtained in the same manner. To obtain the desired results the razor and material must be kept moist with water (for fresh material) or alcohol (for preserved specimens). To prevent shrinkages the sections shaved off are brushed into water or alcohol. For quick examination the sections are placed on a slide with a drop of glycerine. The thin ones that show the cells clearly can be stained for permanent use. In fact staining is a process of adding dyes to show the different tissues in different colours. Many stains are dissolved in alcohol and before staining the sections must be placed in alcohol. After a certain period in the stain(s) the section is transferred to a series of watch glasses full of alcohol. This removes the water and excess stain. The alcohol is removed by dipping the sections in clove oil or benzene. The section is then placed on a clean glass slide with a drop of Canada Balsam (a resinous glue). A cover-slip of thin glass is added and sealed by warming to harden the balsam. The slide (properly labelled) can be then kept and examined whenever necessary. Details of time exposure for staining vary with the stain and the material used. They must be obtained from a text-book or worked out by practice.



Do some plants also move?

We all know that most of the animals are able to move from one place to another on their own while most plants remain fixed at one place for their entire lives. However, it is interesting to note that there are some plants which are able to move under their own. For example, slime molds have ameba like movement whereby they 'coze' from one place to another. Some types of algae have whiplike flagellas they use to paddle themselves through the water. Many plant, particularly the lower ones, produce mobile male gametes which swim about in order to find eggs to fertilize. Apart from these exceptions, the plant movement is usually confined to the movement of certain structures while the plant itself stays fixed in one place.

There are three basic types of plant movement: (I) tropisms, (II) nutations (III) nastic movements.

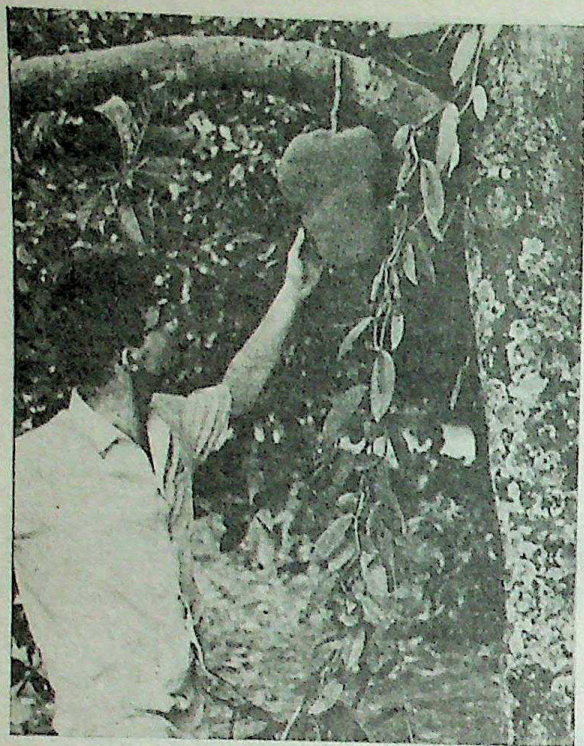
A tropism is a growth response caused by a specific environmental stimulus. The direction of growth is determined by the stimulus.

A positive tropism is toward the stimulus, and a negative tropism is away from the stimulus. The tropisms are caused by special growth hormones called auxins. In most of the cases, the stimulus causes the auxins to collect on one side of an affected organ. This causes the cells on that side to grow and divide more quickly than the cells on the other side. As a result, the organ bends away from the side with the most auxins.

The tropism is again of several types. Phototropism is a growth response to the stimulus of light. In phototropism auxins are concentrated on the side away from the light. This causes stems and leaves to grow towards the light. Roots are negatively phototropic and grow away from light.

The geotropism is a growth response to the stimulus of gravity of the earth. Roots show positive geotropism while stems show negative tropism.

The hydrotropism is a growth response to the stimulus of water. Roots show positive hydrotropism and often move great distances toward areas of moist soil.



Where does the
bread fruit tree
grow?

The bread fruit tree is found in the South Pacific islands, and to a lesser degree, in other parts of the tropics. It is an extremely handsome tree that grows upto a height of 60 feet. Its oval leaves are glossy green and quite large.

There are two distinct forms of bread fruits: one seedless, and the other containing many seeds which when boiled or roasted taste like chestnuts.

The bread fruit, which contains a considerable amount of starch, is not really a fruit in the popular sense and is rarely eaten raw. It can be boiled or baked and served with salt, butter or syrup or even sliced and fried like potatoes.

We can say that bread fruit originated in Malaya since it has been cultivated there from the time immemorial. From here it spread throughout the tropical South Pacific region in the prehistoric times. Its introduction into the New World was connected with the memorable voyage of Capt. William Bligh in HMS "Bounty"—a voyage recommended by Capt. James Cook, who had seen the bread fruit in the Pacific islands and felt that it could prove a useful food item for the Negro slaves in the West Indies. After the failure of Bligh's first voyage, a second resulted in the successful establishment of the tree in Jamaica.

Although since then its numerous varieties have been cultivated in the pacific islands, it is unknown in tropical America. The tree cannot withstand the frost and then has not been successfully grown even in the southernmost parts of Florida.

In the South seas cloth is made from its fibrous inner bark. Its wood is used for canoes and furniture, and glue and caulking material are obtained from the milky juice.



What is the art of bonsai?

The bonsai is the art of developing and growing dwarf trees. The bonsai specimens are ordinary trees and not hereditary dwarfs. They are dwarfed by a system of pruning the roots and branches and training branches by tying with wire. Any tree or shrub would be called a bonsai if grown in a suitable container and kept dwarf by special horticultural techniques.

This art originated in China about 1000 years ago, but it was pursued and developed by the Japanese in the 12th century. In fact, bonsai is a Japanese word which means 'tray planted'. During the 12th century, many westerners came to admire bonsai. But it was not until the end of the World War II that it became really popular in the western world. Soon bonsai societies came to be formed in many countries. Today many Japanese families even have a flourishing overseas trade in bonsai.

The inspiration for bonsai in fact, comes from the nature itself. The trees grown in rocky crevices of high mountains or overhung from the cliffs remain dwarfed throughout their lives.

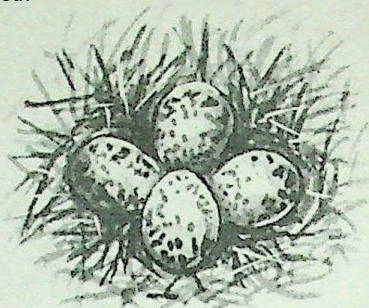
The potted trees selected from a nursery can be trained as bonsai by cutting them back appropriately and wiring their branches to control their shape and growth. The bonsai must be repotted every one to five years, depending on the species and the extent of the root growth. The gradual and systematic root pruning during transplanting in subsequent years, reduces the size of the soil ball. Then the tree can ultimately fit into the desired small and shallow container. It is watered as frequently as other plants. The fertiliser used is liquid and the pruning and nipping of shoots is performed through the growing season.

The containers in which bonsai are grown are as vital for such a growth as the tree itself. The bonsai pots are usually earthenware. They may be round, oval, square, rectangular, octagonal or lobed—and have one or more drainage holes in the bottom.

Miniature bonsai may range up to two inches in height and require three to five years to grow. Small bonsai, two to six inches in height require five to ten more years. The medium-sized ones six to twelve inches in height can be produced in three years.

Bonsai may live for a century or more and be handed down from one generation to another as a valued family possession.

In Japan its a flourishing trade. There is a considerable industry of considerable size exists today. In California (U.S.A.) also this industry has started operating on a medium scale.



Why do different birds have eggs of different colours?

It is a well-known fact that different birds lay eggs of different colours. These can be white, blue, green, red-brown or yellow. Further they are often covered by a pattern of spots, blotches or streaks. Do you know the reason behind it?

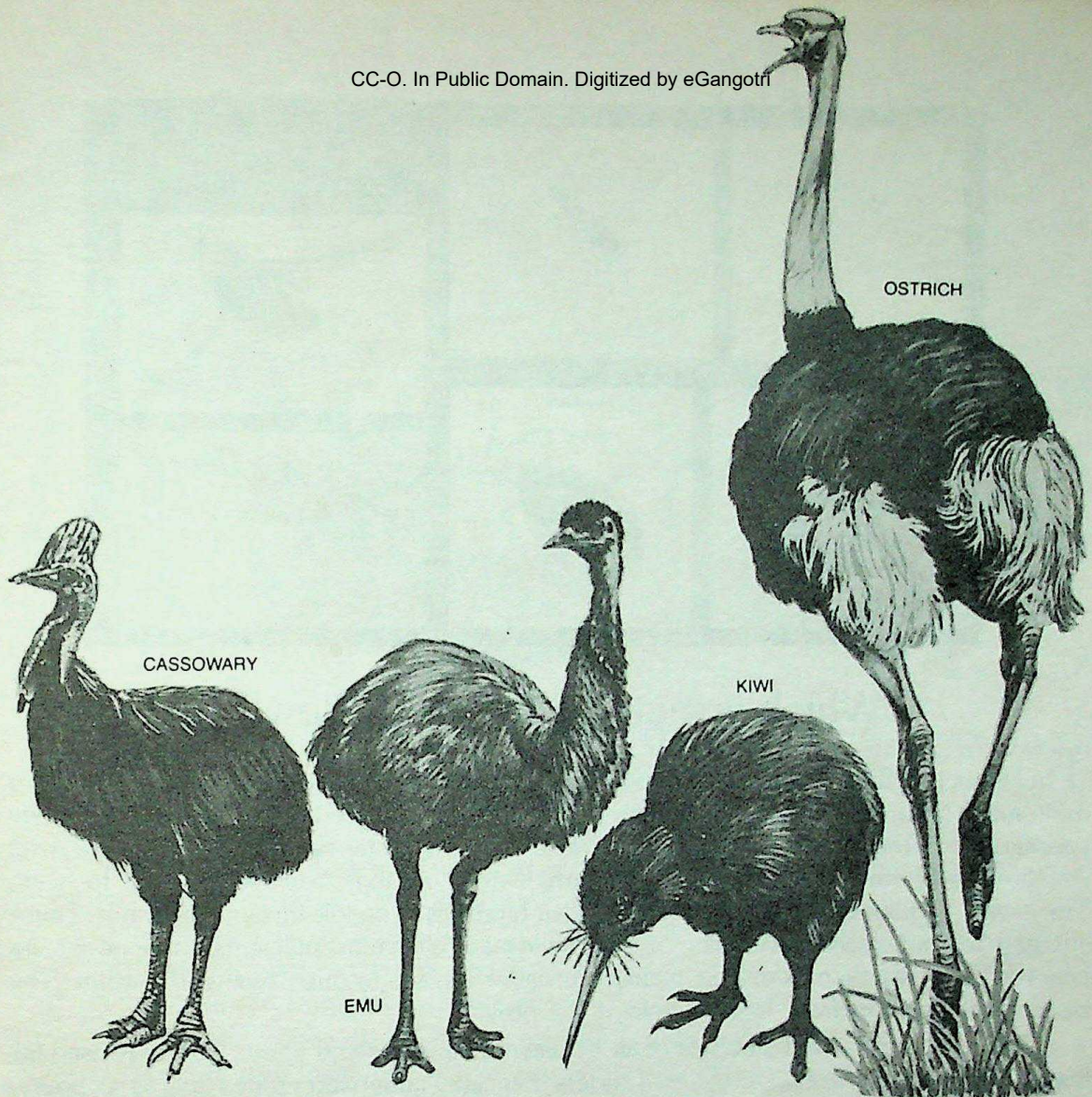
Why it is so is not fully clear to the ornithologists, but in ground-nesting species the colour and pattern help to camouflage the eggs. When mother bird goes in search of food, eggs have to be left behind in the nest. During this period the eggs can be destroyed or eaten by other birds, snakes, squirrels, rats or even man. So the nature has devised this method to protect these eggs.

The spiny lays her eggs in a hollow among coarse meadows. The eggs are spotted and blotched with large markings which look like the rough grass around them. The little tern lays her eggs among the beach pebbles. Speckled and shaped like the pebbles they get mingled with them. Birds which make their nests in a hollow tree or in holes or burrows, generally lay white or light-coloured eggs which would be easily spotted if they were laid out in the open. There are many examples of this protective colouring.

Perhaps the strangest example of protective colouring is that of the cuckoo's eggs. The mother cuckoo lays her eggs in the nest of another bird, taking out one of the eggs already there and replacing it with one of her own. The egg that she lays is almost of the same colour and has similar markings as the other eggs. A collection of cuckoo's eggs from different nests look like a collection from different birds. This is how the birds get their eggs protected from the enemies.

Which birds cannot fly?

There are several species of birds on the earth which cannot fly because they gave up the use of their wings many thousands of years ago. Perhaps their living conditions were such that they did not need wings. They either lived in places where there were no enemies to prey upon them, or were so big that they could rely on their legs to carry them out of trouble. As a result, their wings almost fell into disuse and they gradually became flightless.



Do you know which are the birds which can not fly?

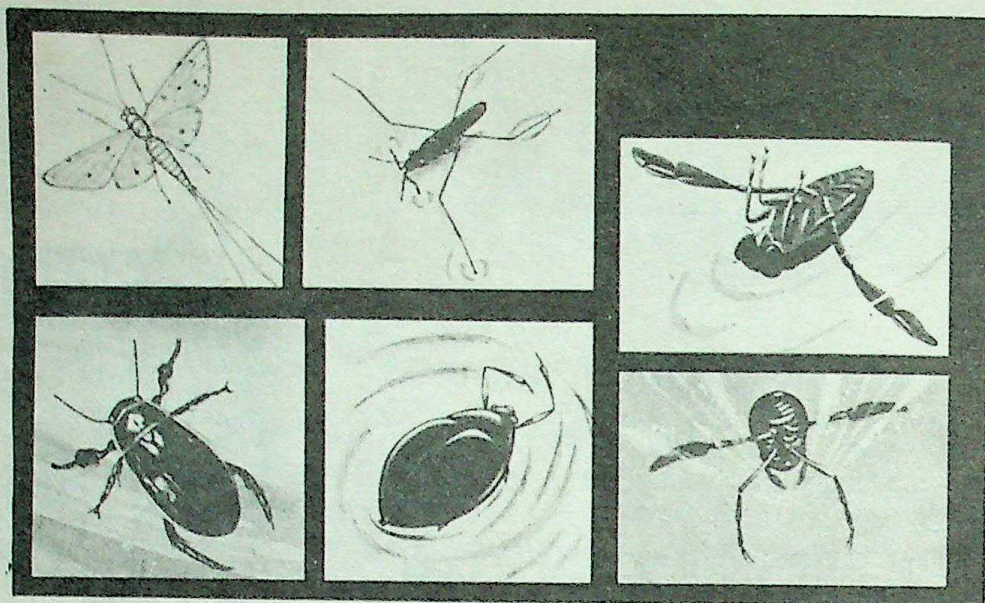
First of all we have the penguins. They turned their wings into paddles or flippers. As a result they cannot fly but they are excellent swimmers. These birds mainly live in the southern hemisphere—mostly at the edge of Antarctica.

The Kiwi of New Zealand took to living by night, finding his food by smell. Gradually the bird became flightless. Since it almost stopped using its eyes so today he has very poor sight. The birds have wings but they are small and hidden by hair-like feathers that cover the body.

The most ferocious flightless bird is the cassowary who lives in Indonesian jungles. He fears neither man nor beast, and is quick to attack with the talons on his long legs.

The biggest flightless bird in the world is the African Ostrich. Growing to 2.5 metres tall, he can run at a speed of 40 miles per hour, covering 4.5 metres in one stride.

The next biggest is the Australian emu which is also flightless. A South American bird rhea is also flightless. These birds were hunted down in thousands when feathers were in demand for hats and fans during the last century.



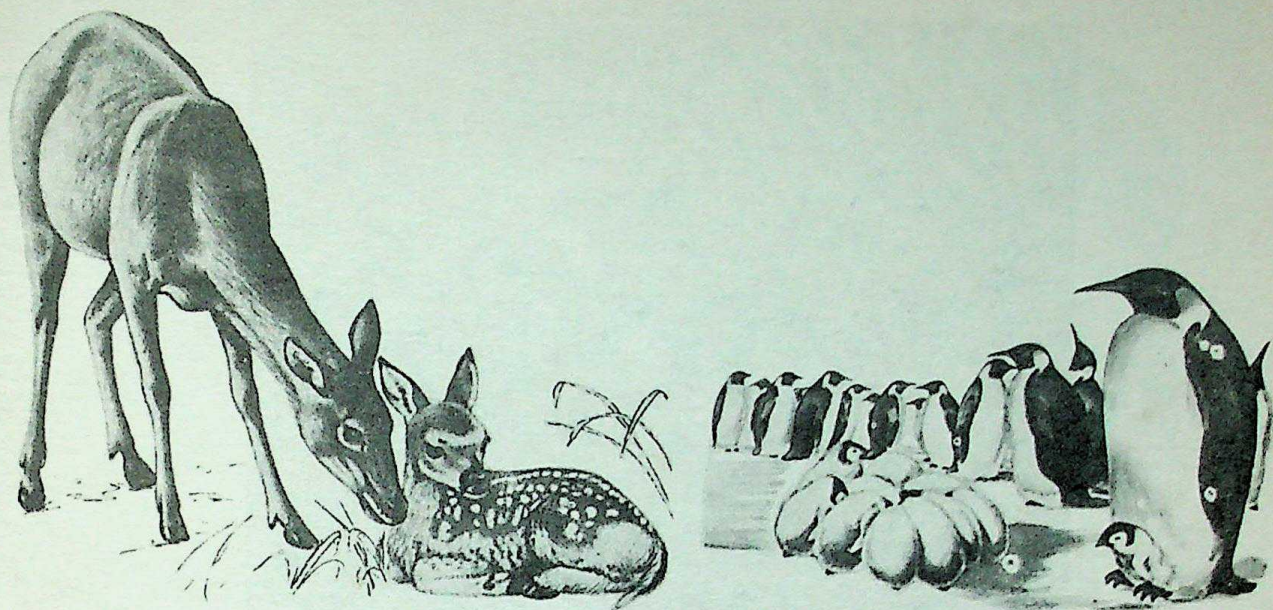
Which insects swim upside-down?

There are certain peculiar type of bugs called 'Black Swimmers' (Greater-water Boatman) that can swim upside down. These back-swimmers are also called boat bugs. Although they spend most of their lives in water, they are able to fly long distances. These insects are small usually 3 to 17 mm (0.13 to .63 inch) in length. Instead of wings they use their legs to swim. They swim on their backs and make use of their hind legs to paddle through the water. These flat 'paddles' are ideal for swimming, and are often made even more efficient by a fringe of hairs which runs down each side. This makes a broader surface to push against the water. The insect uses its short front legs for holding the prey.

Back swimmers hold a bubble of air between their wings and body. This air is used for breathing when they are underwater. This lets them stay underwater for as long as six hours. Back swimmers spend their winter buried in the mud at the bottom of a pond or stream.

They have sharp beaks which are used for stabbing fish and other small water animals. Through them they suck out their juices. Back swimmers some time even bite human beings.

These creatures belong to Notonectidae family that has in all about 200 species. They are found generally all over the world. They cause great harm to fishes and tadpoles. They deposit their eggs either on or in the plant tissue of pond vegetation.



How do animal mothers recognise their young ones?

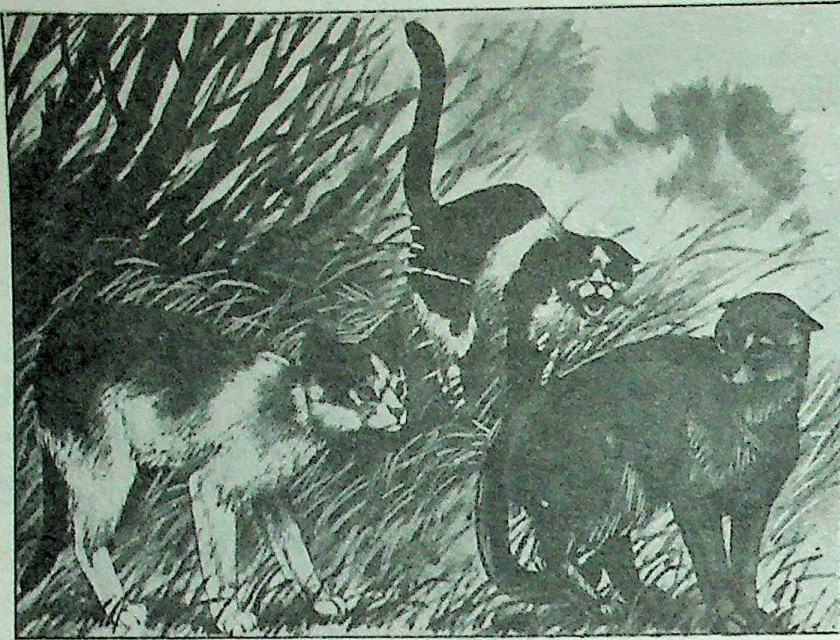
To a scientist, an animal is anything that is living, but is not a plant. The list of animals includes creatures, ranging from those that can only be seen through the microscope, to the mountain-like whale. Today there are more than one million kinds of animals living on our earth. Do you know how the animal mothers recognise their own young ones?

Among the animals where parents care is prevalent, it is important for the mother and young one to recognise each other, so that they do not lose contact. This is done through one of the four senses: smell, sound, sight or touch.

Most of the mammals recognise their youngs by smell. It is common practice among deer, sheep, horses and seals. It's interesting to note that among a flock of sheep every mother can recognise her own young one by smell and ignore others. Among some other animals, when a young one is born, its mother sniffs it and remembers the smell. From then on, whenever the mother wants to find her baby, she would sniff all the babies around until she finds her own.

Among the birds recognition is more by sound. Each parent bird has her own special 'mother call' which the baby immediately recognises on hatching. An Austrian naturalist, Dr. Konard Lorenz, has made a special study of geese. He conducted his study just before some goslings were about to hatch. At that time he removed the mother goose and sat by the eggs himself. As the babies hatched he gave the 'mother call'. As a result, they followed him everywhere. But since he was too big for the young geese they got confused when he stood up. However they were quite happy to follow him when he crawled about on hands and knees.

To some young animals, shape and size are also important. Touch also plays an important role in the recognition of young ones.



Why do cats purr?

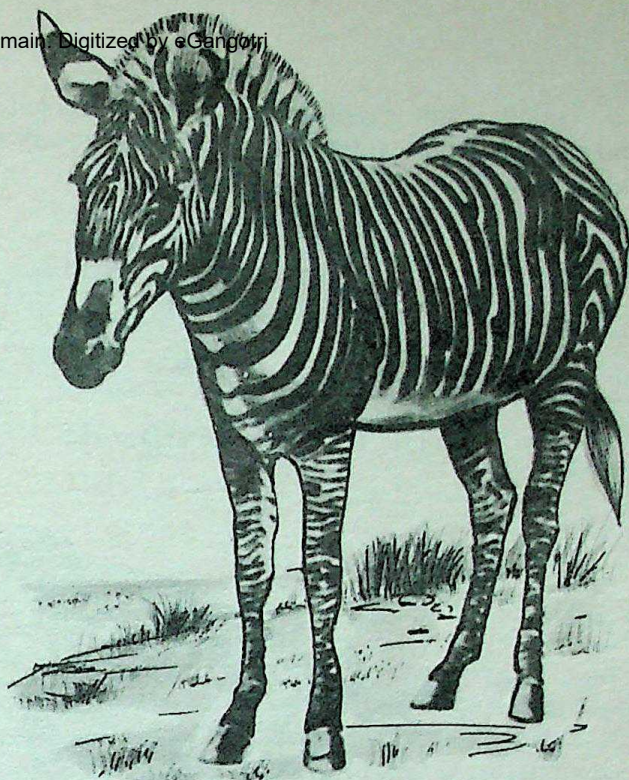
When a cat wants to express contentment or pleasure, it purrs. Purring is a kind of low, continuous rattling hum and has nothing to do with a cat's real voice. A mother cat purrs when it wants to call her kittens for feeding. At the birth the kittens cannot see, hear or smell. So in the initial stages after the birth, it's the purring of their mother that helps them to communicate with her. Once the kittens are feeding, the mother stops purring. So it would seem that purring began as a kind of homing device.

Now the question arises how a cat produces the purr?

The purr is caused by the vibration in the cat's vocal cords. When a cat takes air into its lungs, the air passes through the voice-box that contains the vocal cords. If the cat then wants to express its satisfaction about something, it will allow the vocal cords to vibrate as the air passes in and out of the lungs during breathing. When it chooses not to purr, the passing air does not affect the vocal cords and thus doesn't produce any such sound.

Although there are many other members of the cat family such as lion, tiger, leopard, cougar, jaguar, ocelot and lynx their throat structure is quite different as compared to the cat, and so they cannot purr. However, they can make different kinds of sounds.

Why are zebras striped?



The zebra is a member of the horse family. But as compared to other members of this family it stands apart because of its striped coat.

Today we have three species of zebra that have survived over the ages. The most commonly found is *Equus quagga*—known either as the common zebra or as the plains zebra. It inhabits eastern and southern Africa—south of Ethiopia. The other species is '*Equus grevy*' which is found in Somalia. It is the largest of all zebra species and has numerous thin stripes and very large ears. The third surviving zebra species is called the mountain zebra or '*equus zebra*'. It has numerous narrow stripes and is found in the mountains of Namibia (South-West Africa) and Angola.

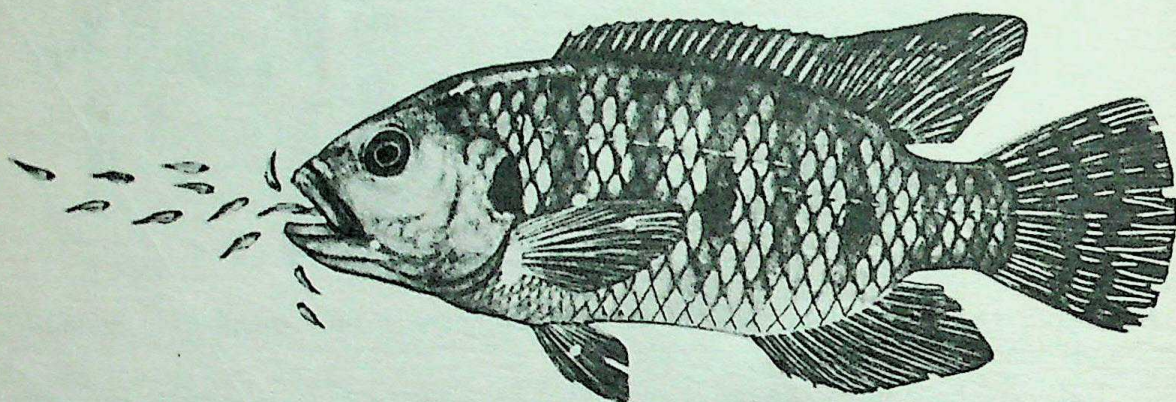
Since all the species have parallel black or brown stripes on white background, it is not off the mark to assume that the stripes must in some way be helpful for these grazing animals. Although a number of theories have been advanced to explain this phenomenon, none gives a very convincing explanation to this effect. According to one theory, the stripes create a 'dazzle pattern' and thus help the zebra to hide from its enemies by blending with the 'shadow-sunlight' patterns where it lives. Since the lion is its main enemy this physical characteristic helps to protect it. Some other researches have suggested that the stripes are disruptive, and break up the zebra's outlines as individuals when they are bunched together at the waterhole, and therefore making it difficult for a lion to single out a victim.

The zebras are grazing animals while some kinds roam around open grassy plains, others live in rough mountains. They usually live in small bands. They are noted fighters, and difficult to tame or train.

The gestation period in a zebra varies from 300 days (the minimum figure of the mountain zebra) and 390 days (in the case of Grevy's Zebra). Usually one young one is born at a time, although twins are also a possibility.

Today certain species of zebras are nearly extinct. At one time a species called 'quagga' had existed. It had stripes only on its head. It was mercilessly hunted down for its meat, and skin. Finally it became extinct in about 1880.

Which fish keeps its eggs in its mouth?



There is a peculiar species of sea-fish that keeps its eggs in its mouth. It is the catfish found in the Atlantic Ocean off the east coast of America. The most surprising fact about it is that instead of the female, the male takes on the responsibility of looking after the future family. After the eggs have been laid and fertilized, the male quickly puts them up into his mouth. They form quite a mouthful as they can be the size of marbles and number upto fifty. They completely fill its mouth and prevent it from feeding. It carries them around for a month. All this time it is fasting, living off the food reserves it built up before the spawning. What's more 'his motherly role does not end even after the egg hatching'. For another two weeks, the youngsters swim into his mouth to hide when danger threatens.

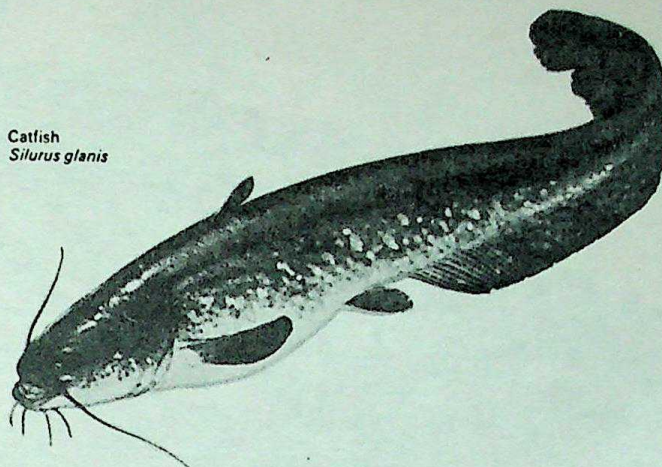
There are seven kinds of fishes which are called catfish and are found in eastern and central north America. Some species, like the flathead catfish and blue catfish, can even weigh more than 45 kg. The catfishes live near the bottom of slow-moving rivers and lakes. They have four pairs of barbels around their mouth. These barbels look like the whiskers of a cat, that's from where the fish got its name. The barbels are quite sensitive and help the catfish feel its way around and find food.

The 'electric' catfish lives in the rivers and lakes of tropical Africa and can grow upto 4 feet in length. It catches its prey by first stunning it with an electric shock.

One kind of catfish called Wels catfish grows of huge sizes in muddy-bottomed lakes in central Europe. Specimens grow to 9 feet in length and some compete with the Arapaima's claim to being the largest fresh water fish in the world.

Sri Vidyabharathi Book Centre, Sringeri

Catfish
Silurus glanis



Can the fishes hear?

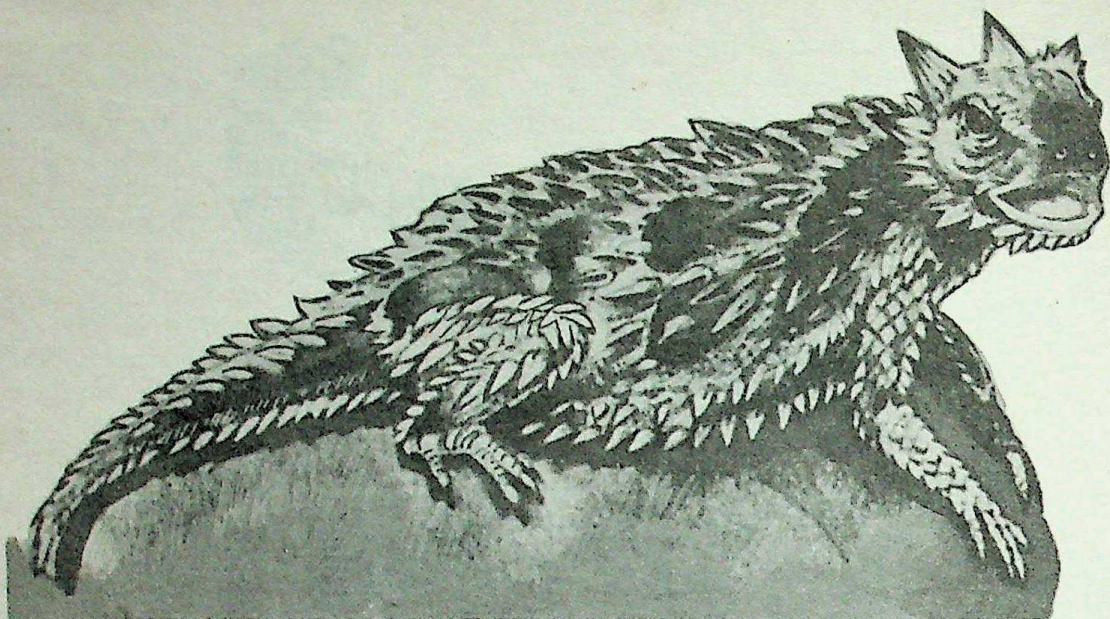
The most surprising fact about the fishes is that you cannot hear them but, they can certainly hear you. The fishes are very well-equipped for hearing. They have a pair of ears. These ears do not have an outer projection as we have, but are simply tiny holes on either side of the head, leading to the inner ear. Since there is no external ear to direct the sound, these ears are probably not as good as our own. But the fishes have other ways of picking up sounds or vibrations in the water.

Along each side of the fish's body is a line of little holes or pores, which can also pick up vibrations and changes of pressure in the water and pass on the message to the brain. This line of pores is called the lateral line, and can be seen quite easily. By using this lateral line fish can avoid all obstacles when it is extremely sensitive to pressure changes caused by vibrations from another fish or some other objects.

Some other teleost fishes such as catfish that lives in rather muddy water have barbels—long sensitive feelers on their mouths.

The fishes of the 'carp' family have tiny bones in the head which are linked with the swim bladder. The swim bladder keeps the fish upright in water and also acts as a sounding board which can pick up and magnify the tiniest vibrations, and then pass these along the bones directly to the inner ear.

These are the different mechanisms in the fishes by which they can hear even very feeble sounds.



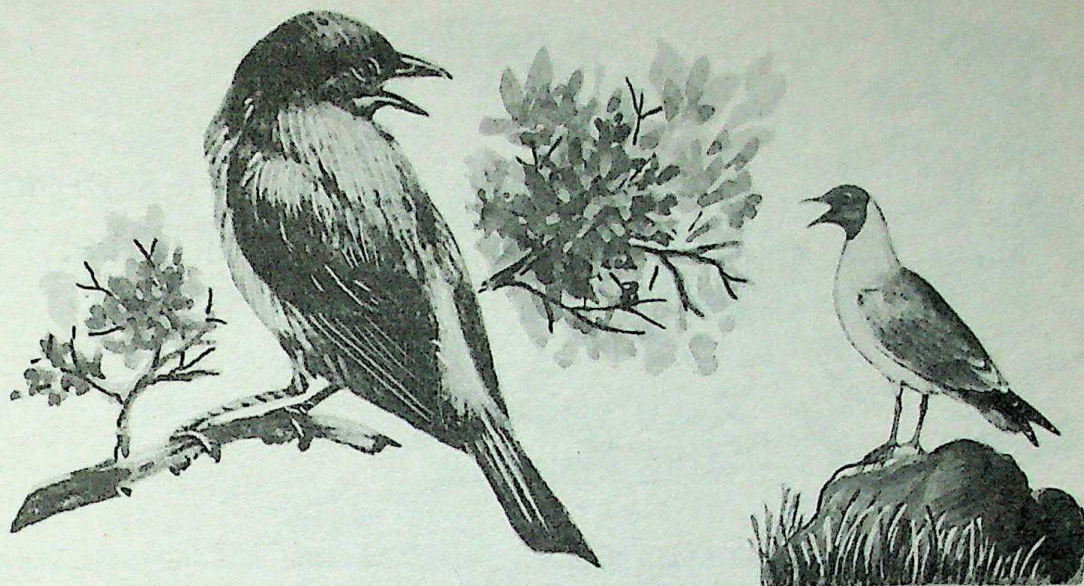
Which lizard squirts blood from its eyes?

There is a commonly found lizard in North America and Mexico which squirts blood from its eyes although very rarely. It is called Horned Toad or Horned Lizard. A number of theories to explain this strange phenomenon have been advanced. It has been observed that on such an occasion the lizard is able to increase the blood pressure in its head, rupture the membranes of tiny blood vessels in its eyes and squirt drops of blood upto a distance of several inches. According to the biologists this action is a defence mechanism. When squirted into the eyes of an attacker, its blood acts as an irritant.

The Horned Lizard belongs to Iguanidae family. There are about 14 species of the lizard. It is characterized by dagger-like head spines or horns. It's typical features include flattened oval body and pointed fringe and scales along the sides of the body. The lizards range in length from less than 7.5 to more than 12.5 cms (3 to 5 inches).

They usually live in desert or semidesert sandy area. They feed on insects, mainly the ants. They conceal themselves by wriggling sideways until the entire body, except the head, is covered.

They are often kept as pets but seldom live long in captivity.



Why do birds sing?

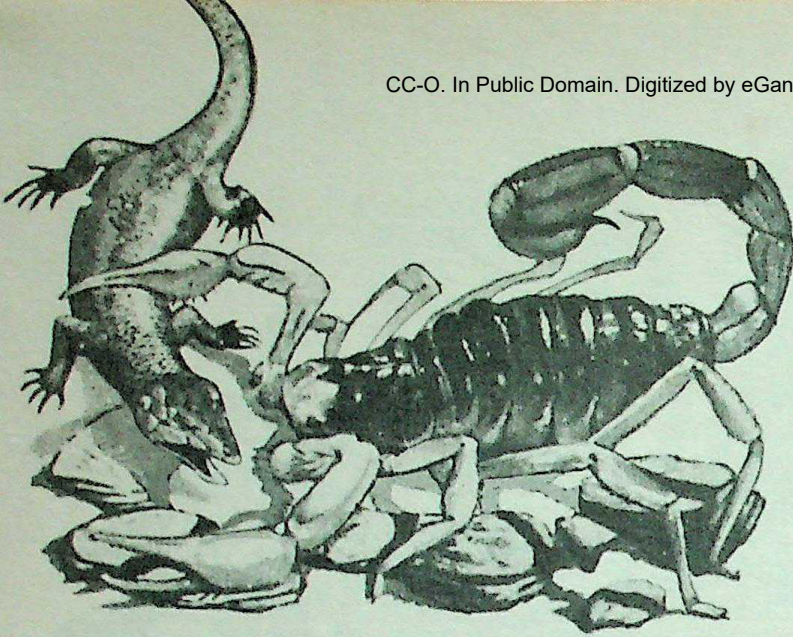
The twittering of birds usually produces a pleasant sensation, especially in the spring in countryside. Some birds produce very sweet sounds while others produce harsh and unmusical sounds. Do you know why the birds sing?

The songs and calls are an important method of communication among birds. They sing to attract mates in the mating season, to warn other birds of danger from predators, and to establish their home territories (nesting area). The bird calls are usually distinctive and vary from species to species. This helps in the identification among the birds.

Among all the species of singing birds, the male is usually the singer. This helps him to attract the female bird. It's interesting to note that not all bird songs are as musical as the nightingale's. The mocking bird has its own harsh call but can imitate the songs of other birds. The crow has a very unmusical voice. Apart from these the other calls involve alarm signals, calls of aggressiveness, calls to parents and calls for food. A few birds such as cormorants and pelicans are voiceless.

Song birds belong to the suborder oscines. Their vocal cords are located in a special box, the syrinx, at the base of the wind-pipe where it divides into two bronchi. The syrinx has a bony structure and forms a sound-box within which membranes vibrate when the bird exhales. This produces varying notes in the bird's voices. The structure of syrinx varies from species to species and till now seven different types have been recognised.

The song of the birds have a pitch of about 4300 Hertz, which is above the highest note of the piano. Single bird calls vary from the deep-pitched hoot of owls to the very high notes of small birds which are scarcely audible to the human ear.



Can a scorpion kill a man?

The scorpions are small insect-like creatures that belong to the class arachnids. They live in the tropical areas of the world. They hide themselves in dark places, under logs or stones and wait for their prey. Their fossil history goes back for 400 million years, and it is believed that they must have been among the earliest of land living arthropods. Today about 600 species of scorpions are known to man.

The scorpions are particularly ferocious animals, and so they lead solitary lives. This habit makes them particularly dangerous to the man. In the houses they find ideal hiding places in shoes, beds and even under the carpets. Once threatened or disturbed, they do not hesitate to sting over and over again. However, the severity of the sting varies from species to species. Most of the scorpions are relatively harmless to the man. Although their sting is painful, generally it's not fatal. However, some tropical species like the Egyptian scorpion, *Leiurus*, can be very dangerous and even cause death. The poison acts by paralysing the nerves of the heart and chest muscles. It is said that in the United States and Mexico more people die from scorpion stings than from the snake bites.

The scorpions are usually black or yellowish, ranging from 1.3 to 17.5 cm in length. The scorpion body can be divided into two major parts. The cephalothorax, which is the thick forward, consists of the head and the chest. The hind part is the long abdomen, which tapers to form a tail. This tail has a stinger at the tip. The animal has six pairs of appendages. The small first pair, called chelicerae, are used to tear apart the prey. The second pair, called pedipalps, are large and have strong claw like pincers. These are held horizontally in front and are used as feelers and for grasping the prey. The last four pairs, each equipped with a pincer, are the walking legs.

The scorpions are nocturnal animals i.e. active at night. They feed mainly on insects and spiders. The female scorpions bear their young ones alive. The newly-born stay with the mother for several days, clinging to her body with their tiny pincers.

The scorpion's stinger is a curved organ at the end of its tail. Two glands at the base give out a poison that flows from two pores. Most of the people fear the scorpion because of its sting. On the other hand, most of the scorpions do not sting human beings unless troubled, and prefer to retreat rather than fight.



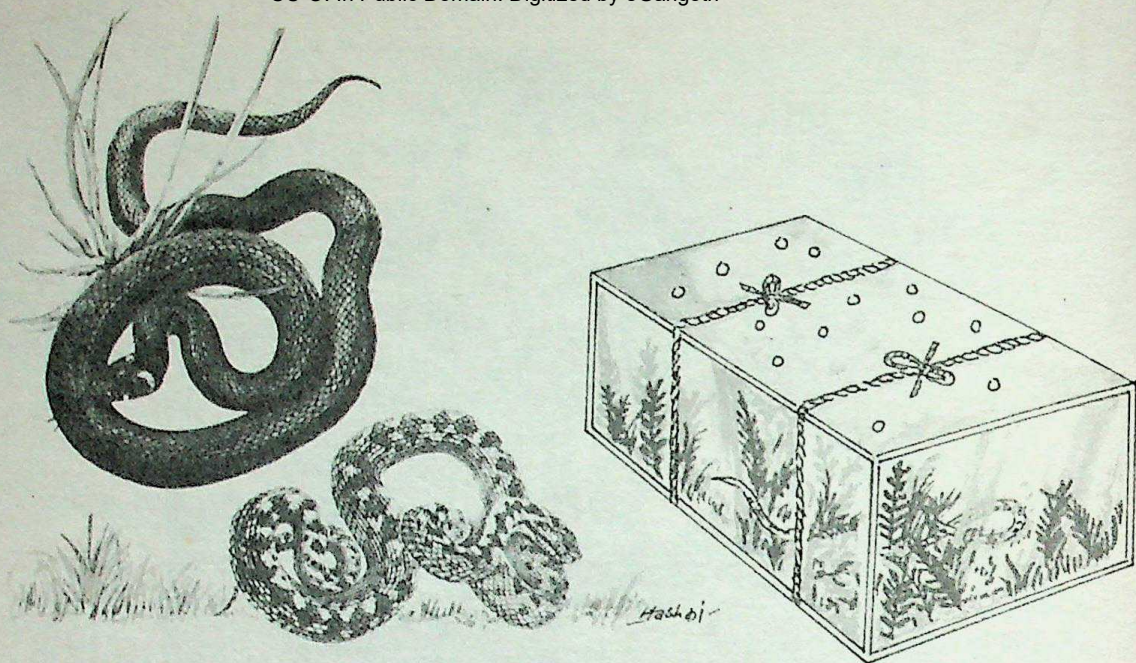
Which animal spends its life upside down?

There is a family of mammals called 'sloth' found in South America, the members of which spend most of their lives in upside down position. They move about the tree tops in very slow motion. They use their hooked claws of both their toes and fingers to move upside down and spend most of their lives in this peculiar position. The sloths can even go to sleep in this position. In sleep, their muscles become fixed and would not relax until the animal awakens and purposely does so. The sloths eat, mate and even give birth to their young in this position.

There are two interesting characteristics related to this strange habit of sloths. The first is its ability to turn its head almost right round to compensate for its reverse position. The second relates to its hair that lies in the opposite direction to that of most of the other animals. The sloth's hair runs from its belly round to its back, and this ensures that heavy tropical showers run straight off.

The sloth hardly has any tail. Its nose is blunt. Its peglike teeth are well-developed. It's difficult to see the animal in trees because green algae covers the animal's hair, providing camouflage. It feeds on the leaves, buds and fresh twigs of trees.

There are two main species of sloths. The unau or two-toed sloth which has two toes on the front: the Ai, or three-toed sloth which has three toes on the front feet.



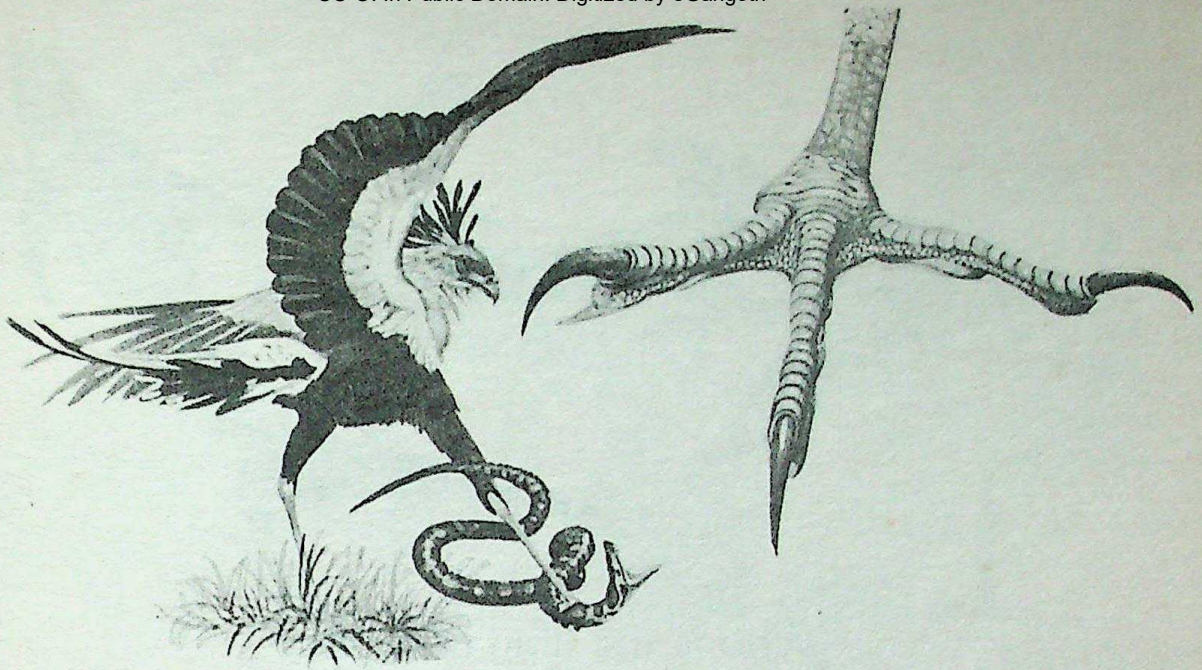
What are snake farms?

The snakes are cold-blooded, long-bodied reptiles. They are found in almost all parts of the world. They are responsible for the deaths of a number of domestic animals and human beings every year. The snakes are carnivorous and can feed on almost any living creature.

Although most of the snakes are non-poisonous some are highly poisonous. The poison called 'venom' is formed in modified salivary glands and carried down the teeth when the snake bites its victim. In hot countries some of the snakes like cobra, taipan, vipers and mamba have such poisonous bites that their victims die almost instantaneously if not given proper treatment.

The best way to protect people against the poisonous bites, or to help them recover from the effects of an actual bite, is to inject them with special serums. These serums are called antivenins. They are poison based, and are made in the laboratories from snake venom. The laboratories need constant venom supplies in order to keep up the manufacture of antivenins.

To meet this demand the snakes are bred on special kinds of farms, where the poison can be extracted from them. They are kept in small domed huts. The men who work here not only need skill but also lot of courage. To extract poison from a snake they have to grab it by the neck and hold it correctly behind the head and catch the poison drops in a cup as they fall from its fangs. One false move and they themselves run the risk of being bitten by them.



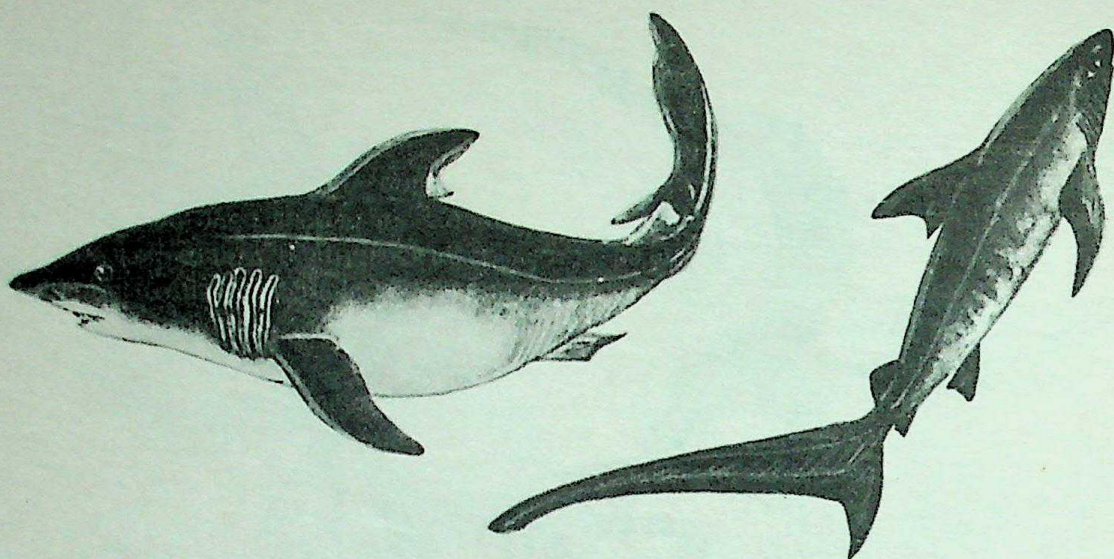
Which are the birds of prey?

The birds which feed on other animals are called the birds of prey. They catch and feed on animals that are usually smaller than themselves. They might catch their prey anywhere on the ground in the air or in water. Not all birds bother to choose their prey. Some even feed on the flesh of dead animals. Do you know which are the birds of prey?

Among the common birds of prey are: buzzards, eagles, falcons, harriers, hawks, kestrels and vultures. Owls also catch smaller animals and feed on them but they are put in a different category. Most of the birds of prey are brown-coloured. They are found on all the continents except Antarctica. They kill their prey with their strong sharp talons, and pluck and tear the flesh with their narrow, hooked beaks. These birds normally swallow huge chunks of food and regurgitate pellets of indigestible matter.

The birds of prey attack in two ways. The kestrel hunts by hovering over open ground, and then plunging down on its prey before it can escape. The falcon stoops or dives head first at its prey and catches it in its talons. The eagles are powerful, soaring birds. Some eagles hide in a tree and wait for their prey to wander into a clearing. Carrion eaters soar on outstretched wings at considerable heights for hours on end, peering down for animals already dead or one about to die. In contrast to it the small birds of prey like the sparrowhawk dash at high speed through trees, to spring surprise on a small creature. The birds of prey kill with their feet. Although some use the beak for the purpose but the sharp, curved talons of the feet are the main killing weapon. The rear and inner talons are usually larger than the middle or outer one. These help the bird to exert a strong pincer grip on the prey.

The birds of prey hunt a variety of animals such as rabbits, hares, grouse, fishes and many other birds.



Who is the king of fishes?

If the lion is the king of beasts, then shark can be called the king of fishes. It is the fastest and most dangerous fish in the sea. It is also the largest of the true fishes, ranging from one foot to over 40 feet in size.

Another good reason for calling it the king is that it is a member of one of the oldest groups of creatures alive in the world today. Some fossils of sharks are believed to be around 250,000,000 years old.

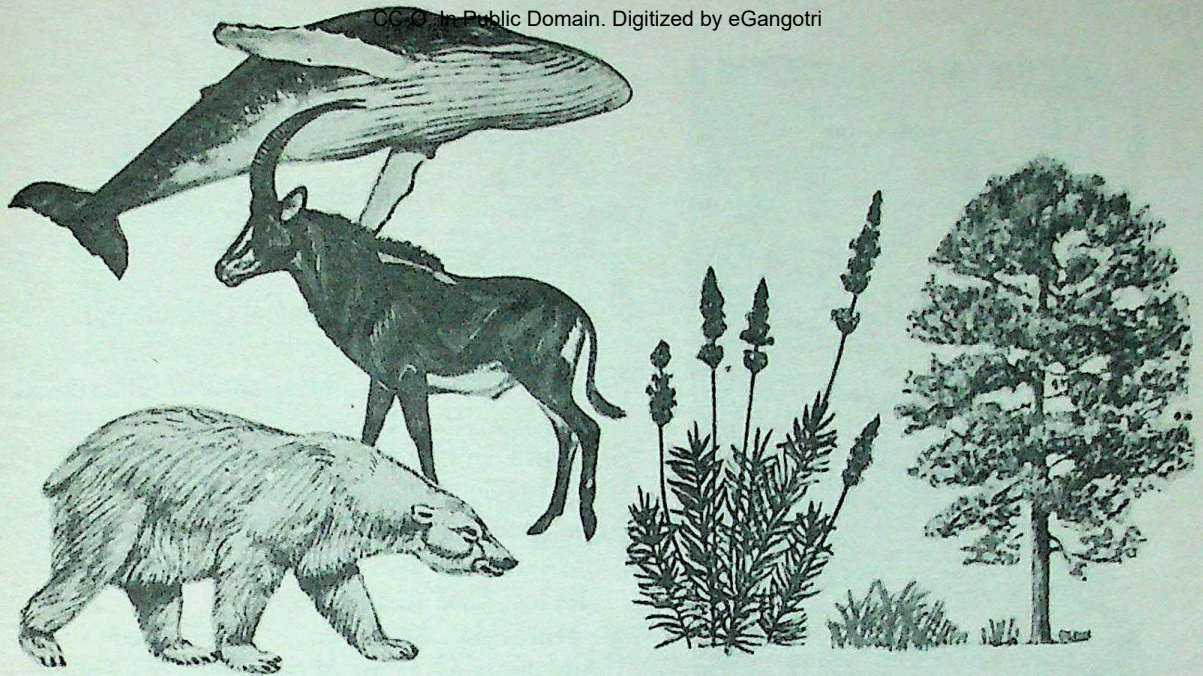
A shark is a saltwater fish that belongs to the class 'chondrichthyes'. Its skeleton is made up of cartilage rather than bone. The shark's skin is covered with many small scales which are like sandpaper.

There are more than 250 different species of sharks in the world. The dog-fish shark grows upto around 1 m in length. It feeds on small fish and invertebrates. The whale shark, the largest of all fish, can reach about 15m long. It is the least dangerous. Many other sharks grow upto the length of several feet. These sharks have many razor sharp teeth.

A shark will eat almost anything found in the sea from the tiniest sort of sea creatures to other sharks, turtles, seals or dolphins. They have been known to swim up-river and attack crocodiles and horses and elephants which might have waded into the water. They are also found to attack people swimming in the sea. When in pursuit of its prey, they can move very fast. They follow the ships to feed on the waste food thrown overboard from the ships kitchens. Some sharks live and hunt alone, while others prefer to roam the seas in packs.

The sharks are caught in large numbers every years. Its meat is very nutritious and cheap, and can be quite delicious if properly cooked. Its skin is used for binding books and covering boxes, and for making bags and shoes.

The most beautiful shark is the mako shark. It is snow white underneath and brilliant blue on the top. It is very fast and ferocious. and a strong fighter when caught on a line.



Which animals and plants should be conserved?

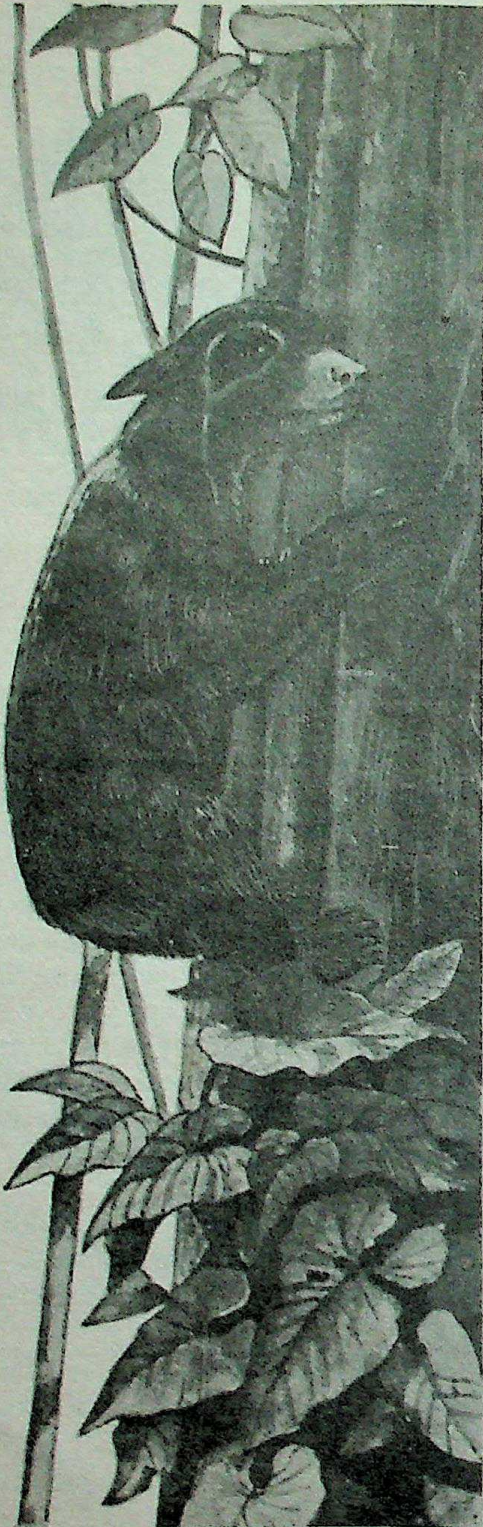
It is important to conserve certain animals and plants because they are in the danger of extinction. Increasing population and changes in the natural environment are endangering the lives of many species of animals and plants. Do you know which animals and plants are threatened with extinction and should be protected?

Man himself is a great threat to wild life in many ways. Firstly, the increasing human population is encroaching on more and more land, and thus creating a scarcity of land for the wildlife to survive. This also includes the effects of widespread farming. Where the forests and heaths have made way for the plough many kilometres of hedges have been removed. Secondly, man has hunted down many animals to extinction. A good example of this is the destruction of the great Auk during the last century, or perhaps even worse the dodo. Today the existence of whales is in danger. Pollution is also affecting the lives of many animals. Every year millions of sea-birds die very unpleasant deaths as their feathers get covered with sticky, black oil waste.

Today the wild animals which need special care include: leopard, lion, puma, ocelot, humpback whale, the giant sable antelope and the polar bear. The number of these animals has been decreasing every year. It is, therefore, very essential to protect them. Once they become extinct, they would be gone forever.

Among the plants there have been many wild flowers that have become rare and are threatened with extinction. Some important ones are red helleborine, cheddar pink, monkey orchid, tufted saxifrage, alpine catchfly and alpine gentian.

Today conservation laws have been made in almost every enlightened country to protect these species. So, that these endangered species don't become extinct.



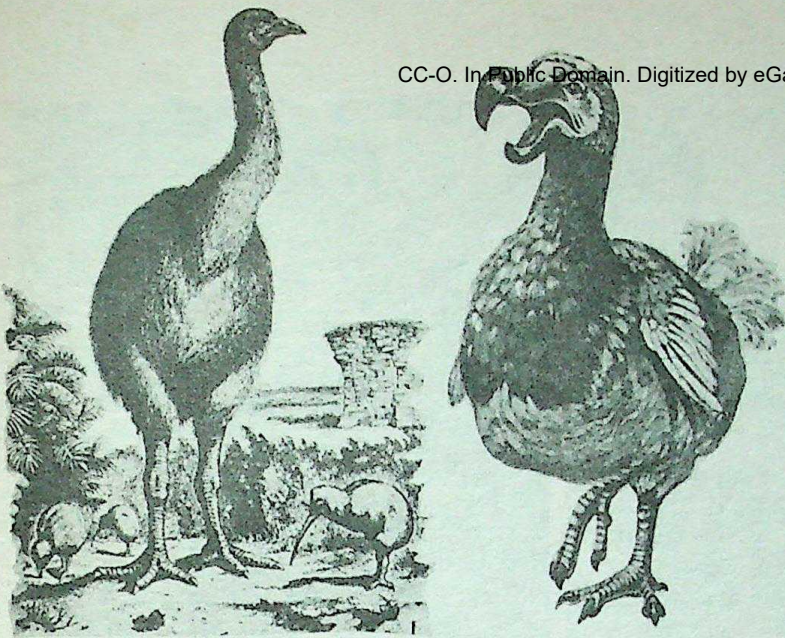
Does any bear wear 'glasses'?

A small bear from tropical south America has odd face markings. It has a creamy yellow snout, with fur of the same colour running down from the nose making interesting pattern. In certain cases the lines of lighter fur usually white encircle its eyes and cross the nose, giving the bear the comical appearance—as if he was wearing a pair of glasses. Due to this peculiarity it is called 'spectacled' bear. It is also called the Andean bear. Some of them may have only the bottom half of their 'glasses', whereas in some others the eye-rings are so thick that they completely fill the face.

Although there is only one species of 'spectacled' bear (*Tremarctos ornatus*), there are many different facial markings within the same species. Although all the bears can climb trees, the spectacled bear is particularly expert at clambering through the branches to feed on leaves, fruits and nuts.

The 'spectacled' bear is the smallest among the bears. The adult is upto 64 cms (about 25 inches) at the shoulders, 120 to 180 cm (4-6 feet) in length, with about 7 cm long (3 inch) tail. The colour of its shaggy coat varies from dark brown to black. It weighs less than 135 kg. Although it may feed on small mammals, deer, guanacos and vicunas its diet mainly consists of fruits and leaves. It usually lives in cool mountain forests.

Litters of one to three cubs have been born in captivity after a gestation period of 8-8½ months.



Which animals
have become
extinct over
the ages?

The study of the fossils has revealed that hundreds of species of animals and plants have come and gone since the creation of the earth. To begin with these species became extinct as a result of natural causes. The animals and plants that disappeared were those that were unable to adapt fast enough to the changing conditions of earth or were unable to compete with their rivals for the available food supplies. However, there are other instances such as dinosaurs, in whose case the reason of their extinction is still not very clear. The animals which became extinct millions of years ago were never seen by the man. But then there are some others that were alive only a few hundred years ago. And in their case the man himself has been responsible for killing them and causing their extinction. Do you know which animals became extinct during the last few hundred years?

There was a bird called dodo which became extinct by the end of 17th century. This bird lived on the small island of Mauritius in the Indian ocean. It was hunted down by the sailors for food and thus gradually it vanished without leaving trace. The same story marked the extinction of another bird called the Great Auk. This penguin-like bird lived on the islands north of Scotland as recently as some one hundred years ago. Egg collectors and hunters drove it to extinction in 1844.

Another species of large bird extinct today is Moa, which lived in New Zealand, and must have been 10 ft. tall. It was like a large ostrich and could not fly. It was probably hunted down by the ancestors of the Maoris when they reached the island of New Zealand about 600 years ago.

However, these are not only some birds, that have suffered their fate. One other famous lost mammal is the sea-cow. There are a few 'family' members of this sea-cow that are left. They are the manatees and sirens. They live in water and look like a seal. The sea-cow was found by some Russian explorers shipwrecked on Bering Island in 1781. They were also hunted down by the sailors. They were so fiercely hunted that within 27 years they had become extinct. Oryx, an antelope-like animal from the deserts of Arabia was almost wiped out by the hunters.

These are only some examples of extinct animals, but there may be many others that have also become extinct.



How do plants and animals defend themselves?

Almost every plant and animal in the world has enemies that threaten its existence. So to protect itself every living being has developed some defence mechanism. In face of enemies some organisms hide, others run, while others just fly away.

Some organisms can even hide without moving. They use 'camouflage colouring'. That means that their skin colour blends in with the surrounding area so well that the enemies cannot see them. The chameleon has the capacity of changing its body colours. If it is on green leaf, it turns green. If it is on a brown twig, it turns brown. Some rabbits change colour with the season. The snowshoe hare is brown in summer and white in winter. The white fur camouflages the rabbit in the snow. Another phenomenon called countershading is a common type of camouflage among the fishes. The underside of their body is of lighter shade than the top. This helps the fish to blend in with many shadows it might make. Some other animals have a remarkable ability to take the form and colour of some other object around them. The camouflage also helps some animals catch their food. Since they can blend in with their surroundings, their victims can't spot them immediately, and thus get caught.

Then there are other animals such as antelope who can run very fast. Others may dodge back and forth, like a rabbit. Birds can escape most predators by flying away.

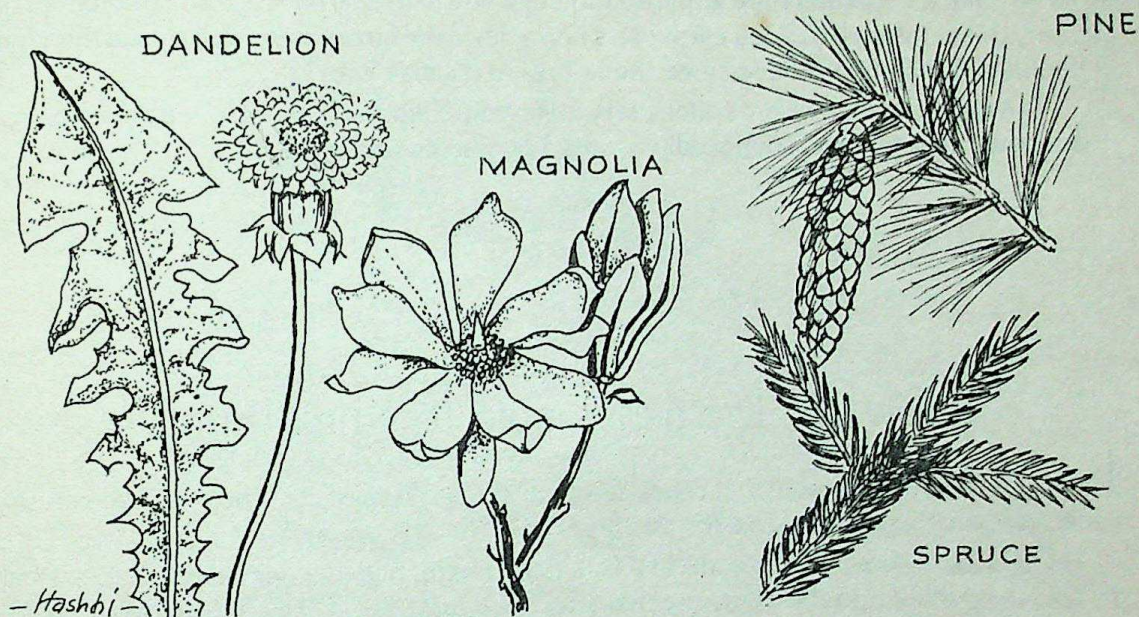
Certain animals have developed physical attributes to flight to survive. Many mammals have sharp claws and teeth to protect themselves against enemies. Snakes bite, bees sting, and skunks squirt an unpleasant smelling liquid. Still some other have such bodies that discourage an enemy from attacking. The quills of a porcupine would injure its enemy.

The puffer fish can swell up like a balloon when it is attacked. This makes it difficult for another fish to swallow it. Many non poisonous snakes have colours similar to poisonous snakes. Enemies think that the snake is poisonous and thus refrain from attacking. This type

of defence mechanism is called mimicry. Some poisonous snakes have very bright colour to warn off enemies that it is near. This is called 'warning colouration'.

Even the plants have defence mechanisms. The cactus has long spines which will prick animals that try to eat it. Many vines have thorns to keep animals away. Some plants are poisonous and will make an animal sick if it eats or touches the plant.

How did different plants get their names?



Ever since the evolution of languages different plants and trees have been given names to distinguish one variety from the other. These names are needed for the gardener's catalogue and for the botanists. It is interesting to trace out their origins. Some names have simply come down to us from other languages, while some others from the places of their origin. Some plants have been named according to the shape and colour. Over the time even the names have undergone changes. Here we shall discuss the origin of names of some of the important plants and trees because it is not possible to trace out the origins of names for the whole plant kingdom here.

The pine tree got its name from the Latin word 'pinus' which means 'a point'. The spruce tree should really be called the "Prussia Tree" because it was long thought to be a native of Prussia. The name gradually got corrupted to 'spruce'.

A butter cup is a flower with the shape of cup and the colour of butter. Lady's mantle was the name given when ladies wore collars that were pleated and with serrated edges like the leaves of the plant. Honeysuckle has flowers rich in nectar and is therefore popular with bees collecting substance for making honey.

The magnolia has been named after Pierre Magnol of France who was a professor of botany. The cypress is called thus because it was first brought from the island of Cyprus. In Madagascar, there is a tree called, "The Travellers Tree". It has large, fan-shaped leaves that catch the rain, and the passing travellers can quench their thirst with its help.

The Barber Plant has been named thus because the natives of orient used to rub its leaves on their faces to keep the beard from growing. The word dandelion comes from the French 'dent de lion' because the leaves of this plant resemble the teeth of a lion. 'Thyme' comes from the Latin word 'Thymus' which means to sacrifice. The Romans used to burn this plant on their altars.

A plant called 'self-heal' got its name because it was thought to have a healing effect on the wounds. Since carpenters are supposed to cut wood with sharp tools more often than other people, this plant is also called carpenters herb. Since the farm workers also used this plant as a bandage, it has two other names: hook-heal and sickle-wort.

The names of many plants often carry a warning. 'Deadly nightshade' is a poisonous plant that grows among ruins supposedly haunted by ghosts and evil sprit.

How are the fishes able to smell things?

It may be surprising to note that fishes can smell things just like the other creatures. And like other animals they have noses for this purpose.

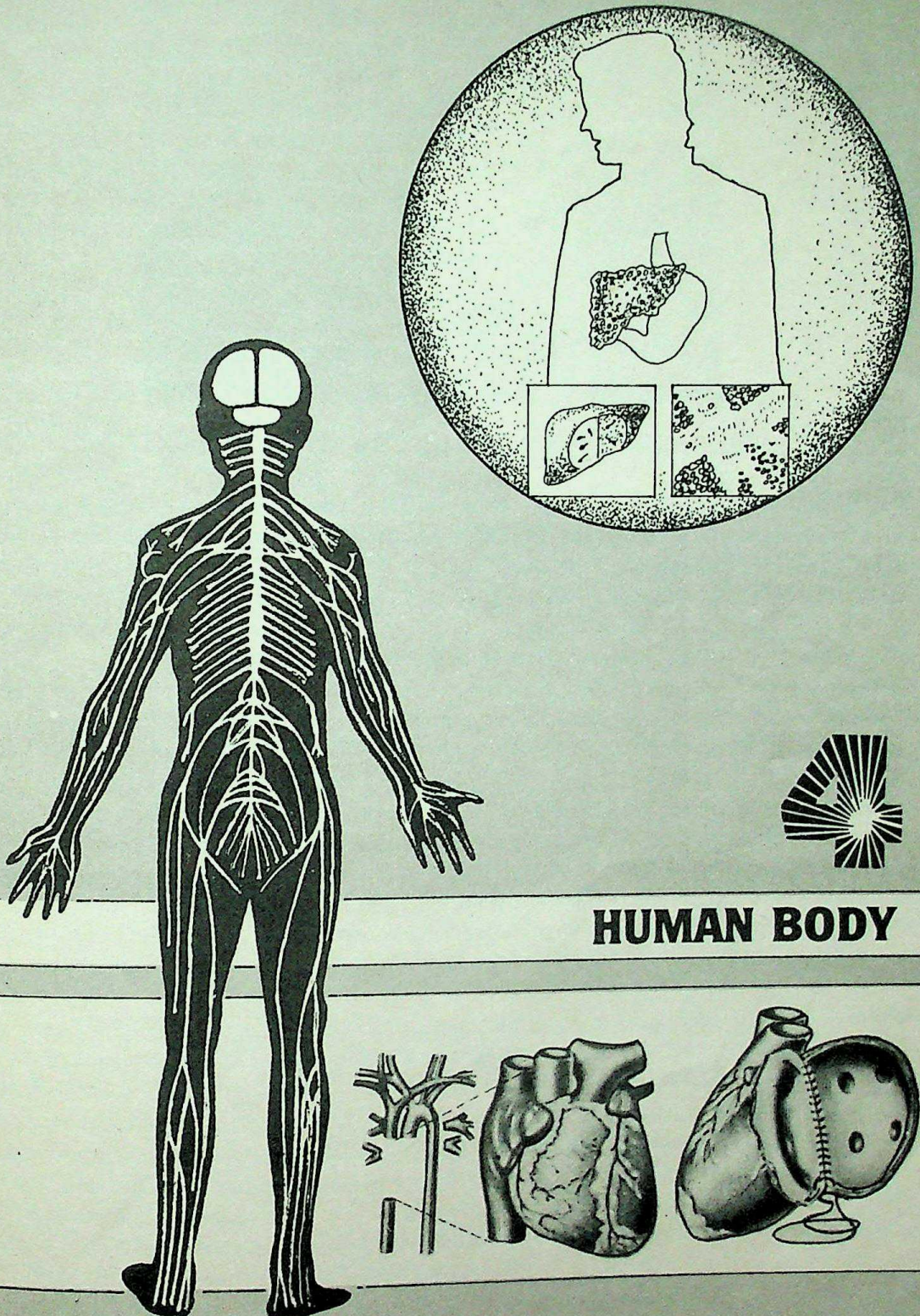
There are two pairs of nostrils in a fish. Each nostril has two openings which are called pits. One opening is in the front, and the other directly behind it. The two are separated by a small flap. However, the location of the nostrils in different fishes may vary from species to species.

When the fish is under water, a current of water enters from the front pit and comes out from the rear one. As the water flows, it stimulates the sense cells that tell the fish about smells. Many fishes have a keen sense of smell. They can detect even the faintest smells.

In fact, the sense of smell may be important to fish in helping them find their way home. Some fish could tell the difference between water from two creeks. But if their noses are plugged, they get lost.

To prove this fact the researchers have performed certain experiments. In one experiment a large number of salmon were taken out of their home stream. One half had their noses plugged; the other half did not. The fishes with plugged noses got lost. The others found their way home again.

Apart from the sense of smell the fishes have other sensory perception also such as the sense of touch, taste, hearing and seeing.





When did the first human heart transplant take place?

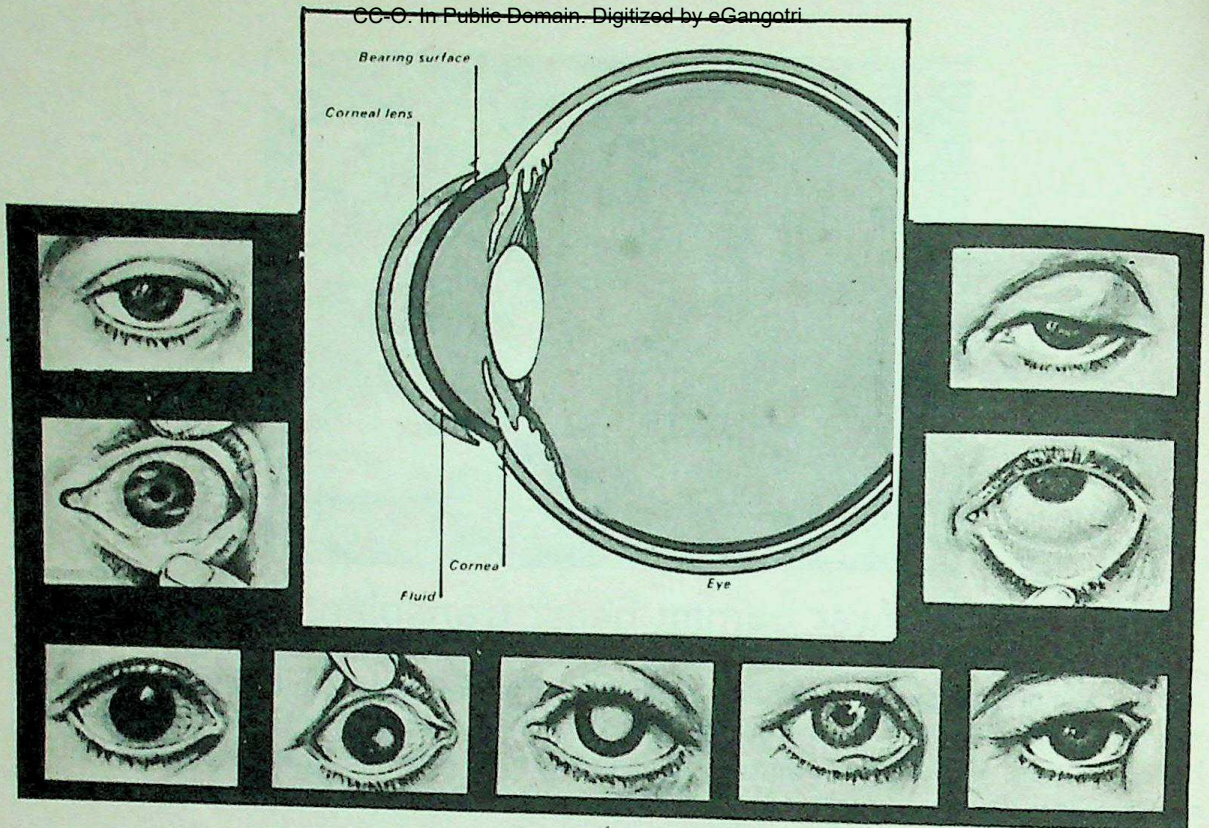
The scope of heart surgery has vastly increased ever since the introduction of the heart lung machine in the 1950s. This machine pumps blood from the veins to the arteries without having to pass through the heart. Most of these machines oxygenate the blood, thus completely bypassing the lungs as well. With its use the heart can be stopped and opened for upto four hours.

It was because of the use of such modern techniques and apparatus that the first human heart transplant became possible. It took place on December 3, 1967, at Groote Schuur Hospital, Cape Town, South Africa. A team of 20 surgeons, headed by Dr. Christian Barnard, operated on Louis Washkansky, aged 55. The donor was 24 year old Denise Ann Darvall, who had been killed in a road accident.

Both the donor and the recipient were of the same blood group and the heart was kept in cooled oxygenated blood for more than three hours before the transplantation. The operation took around five hours, and the new heart was only half the size of Washkansky's. The operation was successful. Within a few days Washkansky had sat up, started taking food and talking happily. The doctors were anxious about transplant rejection by the body and also post-operative infection which, in fact, did kill Washkansky within a month after the transplant.

In January 1968, a second transplant was carried out on Philip Blaiberg, a 58-year old dentist, who subsequently overcame a severe liver infection and lung impairment thought to be the result of his body trying to reject the new heart. It was successful.

So, soon the heart transplant became more popular. As a result, by the end of 1968, more than 100 transplants had been carried out in the United States, Britain, France, India, South America, Canada Czechoslovakia and Israel. More than 40 patients have survived. Blaiberg remained alive until August 17, 1969 and other patients survived for upto two and a half years. Because of the lack of complete success the number of operations declined. From December 1970 to May 1971 only six operations were performed.



Which are the common diseases of eyes?

The eyes are the sense organs that give human beings and most other animals the most accurate and detailed information about their surroundings. There are physicians and surgeons who specialize in treating the eye disorders and diseases. These medical doctors are called eye specialists or ophthalmologists. In fact, ophthalmology is the study of the eye, eye disorders and eye diseases. Do you know what are the common diseases of the eyes?

The conjunctivitis is a common disease of eye. It brings about an inflammation of the conjunctiva of the eyelids and eye ball. It can be caused by either allergy, irritation or infection. A viral form of conjunctivitis, trachoma, is a major cause of blindness in Europe and Asia.

Another infection of eye is 'sty' that affects a gland at the corner of the eyelid. The cataract is a condition in which the lens becomes cloudy or opaque, reducing the amount of light that enter the eye. Its treatment may involve surgical removal of the lens, and either implantation of an artificial lens or the use of special corrective glasses.

'Glaucoma' is an eye ailment that causes increased pressure within the eye ball which puts pressure on, and eventually destroys, the optic nerve. Nightblindness is caused by a deficiency of vitamin A which results in the damage of special cells called 'rods' that enable us to see in dim light. In a 'retinal detachment', the retina gets separated from the choroid and floats in the vitreous humor. This can be caused by a fall, a blow on the head or by any other trauma to the eye. It is treated surgically and in many cases laser beams are used to fix the retina back in place.

Sometimes the retina gets degenerated and leads to the total blindness. The disease of retinal degeneration is called retinitis pigmentosa. There is no treatment for this disease and eventually leads to blindness.

A corneal abrasion is a very painful scratch on the surface of the cornea. It usually heals automatically without causing any ill effects. Corneal scarring, however, results from more severe injury or disease. Since scar interferes with or totally obscures vision, the cornea may be removed and transplanted.

Healthy persons should have their eyes examined by a specialist every one or two years. These regular examinations help keep the eyes healthy by detecting disease or disorders at initial stages.

What are analgesics?

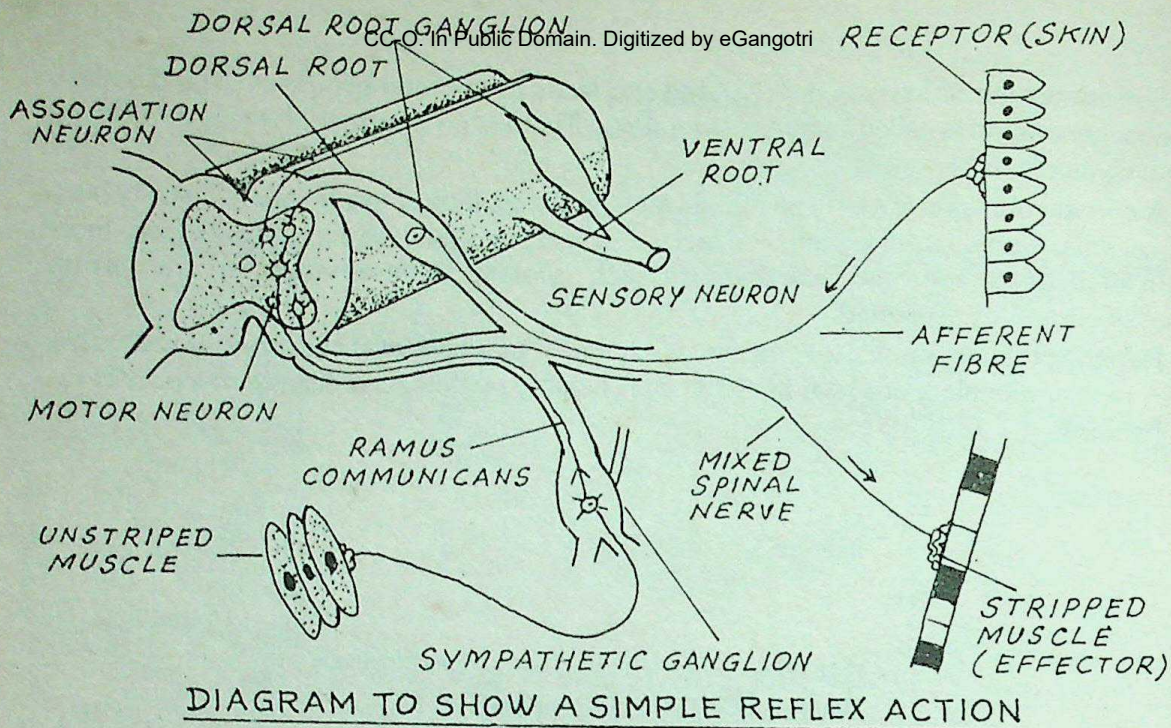
An analgesic is a drug that reduces pain without causing unconsciousness or complete loss of feeling. There are two main types of analgesics. The first is that which acts on pain associated with muscle or bone or their related structures. These are called peripherally-acting analgesics or 'mild analgesics'. The most common of these is aspirin. Its active constituent is acetylsalicylic acid. It was first synthesized in 1899, and has been produced in huge commercial quantities ever since. Other analgesics of this group include codeine and paracetamol. These are used to relieve headaches, rheumatism and other body pains.

The second group of pain killers are the centrally-acting analgesics. They are very potent drugs and include substances derived from opium, an extract of the poppy plant. Two such analgesics are morphine and heroin. In the brain they depress the activity of the cortex and thalamus (the part which receive messages from the body's pain receptors). They are very effective and act instantly when injected into a muscle or vein. They are only used by physicians for relieving intense pain of those who are suffering from cancer, heart attack or severe injuries involving broken bones or wounds.

Both types of analgesics have a number of side effects. For example, aspirin can irritate the stomach, produce indigestion or still more seriously, may cause an ulcer. If used indiscriminately, it may lead to anaemia.

Morphine drugs can cause nausea and vomiting, but this side-effect can be blocked by giving the drug cyclizine along with it. Morphine and its allied drugs can cause addiction when used over a prolonged period.

Some other analgesics such as antipyretics, are used to bring down fever.



What causes a reflex action?

A reflex action is an automatic nervous action in which a stimulus causes a rapid response. For example, if a person accidentally touches a hot stove, he would immediately jerk away his hand before he has time to think about it. In this case, the hot stove is a stimulus, and the jerk is the response.

Reflexes, such as the 'pupil reflex' are quite common. When a bright beam of light hits a person's eye, his pupil automatically becomes smaller. And if the light is taken away and his eyes are shaded, the pupil returns to its normal size. Here the light acts as the stimulus, and the reaction of the pupil is the eye's response.

Reflex actions are of two types : unconditioned and conditioned. Unconditioned reflex actions are exemplified by the reflex tests of the physician. When a doctor tests a person's reflexes, he makes sure that the different parts of his nervous system are functioning properly. One reflex action that's frequently tested is the knee-jerk action. In this the doctor lightly strikes an area just below the knee cap with a rubber hammer. This causes the lower part of the leg to jerk upward suddenly. Such reflex actions are called 'unconditioned reflex actions'. These take place without any special learning or experience.

The conditioned reflex actions are a result of particular internal or external stimuli. Such conditioning process was popularized by the Russian physiologist I. P. Pavlov and his associates. Pavlov believed that whenever there was a response to a particular stimulus, a kind of reflex was established in the brain. However, most psychologists today believe that the mechanism of learning is much more complicated than explained by him.

Now the question arises what causes a reflex action? To explain in simple terms, four basic processes are involved in a reflex action. These are : reception, conduction, transmission and response. The stimulus is received by receptors (nerve endings). Energy

from the stimulus is changed into nerve impulses and carried from the receptor to the central nervous system. The nerve impulses are then sent to the motor nerves. The motor nerves control muscle action, causing the muscles and glands to respond (act). Most reflex acts however are much more complicated and also involve other parts of the nervous system like brain.

More than 90% of all the actions are performed by man's nervous system and reflex actions.

What causes Pneumonia?

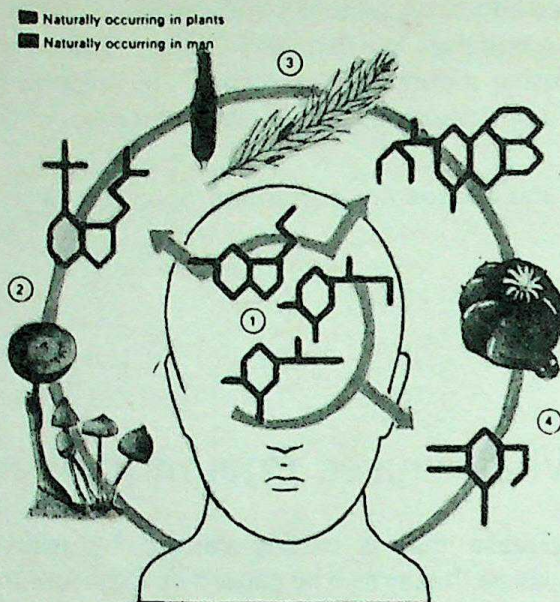
Pneumonia is a lung disease that is usually caused by micro-organisms such as pneumococcus and mycoplasma. It may also be caused by exposure to radiation, such as X-rays, or by breathing in chemical fumes or powders. Its affliction causes irritation in the sacs of the lungs. At this stage, the body pours fluids and white blood cells into air sacs to fight the infection.

The symptoms of pneumonia include chills, fever, chest pain, cough and difficulty in breathing. Frequently, the infected person coughs up rust-coloured phlegm-mucous that contains blood from the irritated lung tissues. The symptoms usually last for a week to ten days until the body's defence mechanism begin to gain control over the disease. It's remedy includes administering of antibiotics that make the patient feel better much faster. The antibiotics have played a major role in reducing the number of deaths due to pneumonia.

The pneumonia that's caused by pneumococcus bacterium is clinically very severe. The pneumococci is present in the bodies of many healthy persons, but is normally kept under control. If the body becomes weakened because of sickness, colds, surgery or exhaustion, the pneumococci can quickly upset the body's defences and cause pneumonia.

The mycoplasmal pneumonia caused by mycoplasma pneumoniae usually afflicts younger people in the age group of 15-20 years. Once afflicted the body can produce an immunity to the organism. Thus very few cases beyond the age of 50 are seen. The mycoplasma pneumoniae grow on the mucous membrane that lines most of the internal lung structures. The bacteria can produce an oxidising agent that might be responsible for some cell damage. The organism inflames the bronchi and alveoli (air sacs).

The pneumonia is called after the body internal organs it affects. The lobar pneumonia affects one or more lobes of the lung. Double pneumonia is lobar pneumonia in both lungs. Broncho-pneumonia affects the bronchi and bronchioles, the tubes leading to the lungs. The pneumonia is a serious disease that should always be treated by a doctor. The patient should get plenty of rest, fluids and fresh air. He should avoid crowds and contact with other people.



THE HALLUCINOGENIC DRUGS

What is L.S.D.?

LSD (lysergic acid diethylamide) is a dangerous hallucinogen that has many side-effects. This drug was synthesized by A. Stoll and W.A. Hotman with compounds derived from a fungus called ergot (*calvicepus purpariea*). This fungus grows on rye and other grasses.

If a person consumes L.S.D., one can notice in him marked deviations from his normal behaviour. This is probably because of L.S.D.'s property to antagonize serotonin. Because of this property L.S.D. has been used by medicalmen as a psychotomimetic agent to induce mental states like actual psychotic disease primarily the schizophrenia.

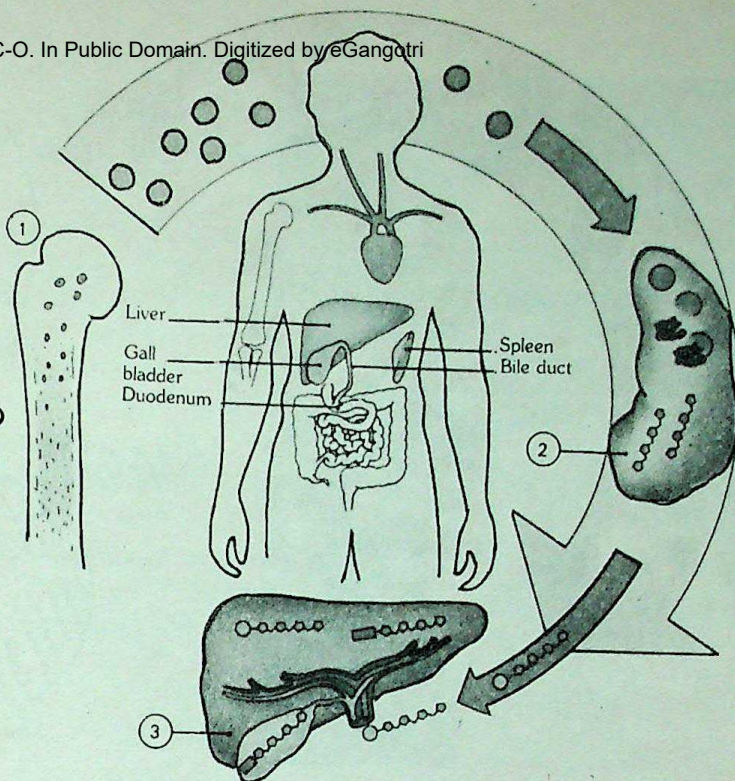
Once consumed LSD is absorbed readily from any mucosal surface and acts within 30 to 60 minutes. Its effects usually last for eight to ten hours. But if a heavy dose is taken its effects can even persist for several days. It produces two major side-effects : prolongation and transient reappearance of the psychotic reaction. Some of the researches conducted in this regard have revealed that its constant use can cause chromosomal and genetic damage.

In the 1960's LSD was proposed for use in the treatment of neurosis. It was also used for treating alcoholism and to alleviate the suffering of terminally ill cancer patients. The drug was also studied as an adjunct in the treatment of narcotic addiction.

LSD can prove quite dangerous for the body if taken indiscriminately. Because of its potent reactions, it is a banned drug and should not be consumed without the prescription of a qualified physician.

In the modern times this drug has played a negative role in the lives of educated youth in the industrial society. But those who are addict to it talk of its role in creativity and expansion of consciousness. But the fact remains that it's a potentially dangerous drug and should not be consumed.

What is jaundice?



Jaundice is a liver disease in which skin and eyes become yellow. It occurs when some of the liver fluid, bile, backs up into the bloodstream and gets deposited in the deeper layers of the skin.

Jaundice is best seen in natural daylight and may not be apparent under artificial lighting. The degree of coloration depends upon the concentration of the bile pigments in the blood, its rate of tissue diffusion and the absorption and binding of bile pigments by the tissue. The bile pigments enter the tissue fluids and are absorbed more readily where there is already inflammation and edema.

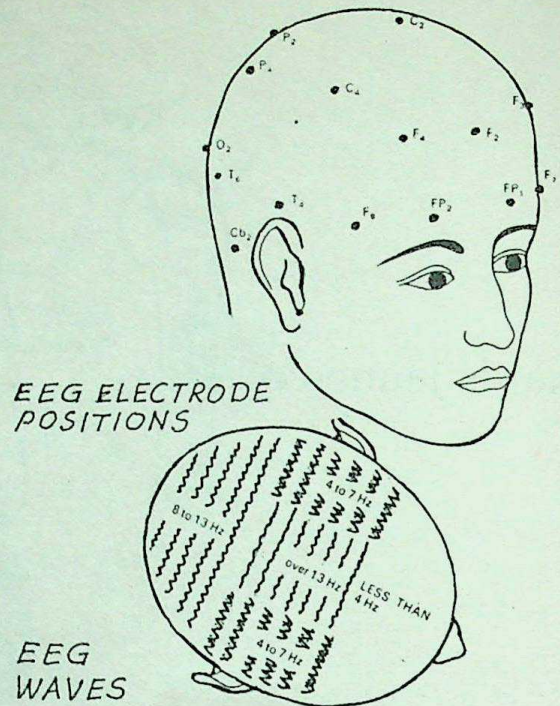
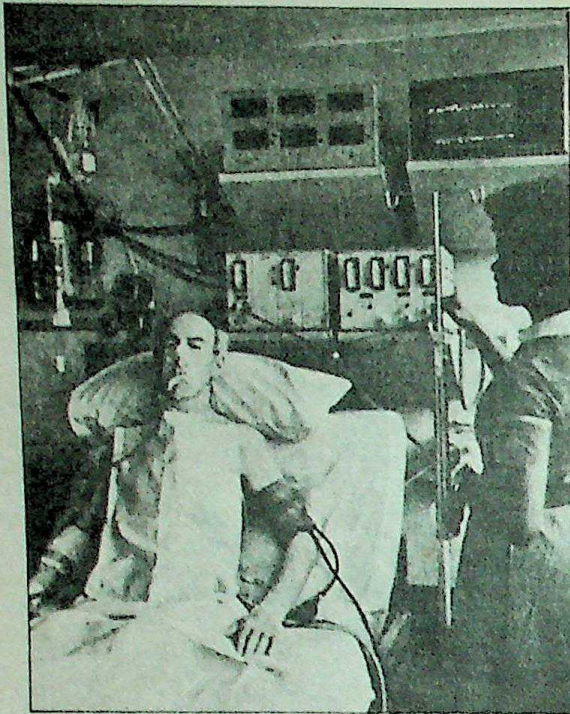
The bile produced by the liver attack fatty substances in the small intestine and partially break them down so they can be more readily absorbed. Most of the bile salts are reabsorbed by the blood stream. But those which are eliminated give the faces brownish colour. Once in the blood, the bile pigments are recirculated to the liver and removed by the liver cells for breakdown and excretion.

The most common cause of jaundice is the extra secretion of bile by the liver. Congenital defects which impair the removal of bile pigments may also cause jaundice. Some liver diseases may also cause malfunctioning of the liver cells which would explain the presence of extra liver cells in the blood stream.

Jaundice is usually of two types : retention jaundice and regurgitation jaundice.

In retention jaundice, the pigments are retained in the bloodstream because of some removal problem. In regurgitation jaundice, there is an abnormal leak back into the bloodstream after it has been removed from the blood or directly from the bile ducts.

Some of the diseases that can cause jaundice are anaemia, congestion in the circulatory system, pneumonia, degeneration of the liver cells, scarring of the liver tissue and tumours in the liver and bile ducts.



What is Electroencephalography (EEG)?

Electroencephalography (EEG) is a bio-medical process of recording minute electric currents produced by the brains of human beings and other animals. This was discovered by Hans Berger of Jena (now in East Germany) in 1929, and found to have important clinical significance in the diagnosis of brain disease.

The brain constantly generates minute electrical currents even during sleep and in deep coma. These can be recorded from the skull's surface by means of small wires (electrodes) attached to the scalp. In normal persons they have an electrical potential of about 100 microvolts. So to make such recording the doctors use a machine that has about 20 equally-spaced electrodes which are attached on the scalp's surface in accordance to the standard positions adopted by the International Federation of EEG. Electrode positions are carefully measured so that subsequent recordings from the same person can be compared with the earlier ones. The electrodes are connected to an amplifier which magnifies the voltages to 1,000,000 times. The current then moves on electromagnetic pen that makes a graph on a chart paper.

In the normal adult person most of the EEG recordings are made up of rhythmic oscillating waves regularly repeated at about 10 Hertz (Hertz is the unit of frequency). They are called alpha waves. They are best obtained from the back of the central nervous system (brain) when a person is in a relaxed position with the eyes closed. The waves disappear or are blocked when the eyes are opened.

EEG normally reveals more rapid rhythmical movement. It consists of smaller waves called beta waves, that are repeated at 18-25 hertz. These are related to the function of sensory motor parts of the brain.

During the sleep, the central nervous system cells generate even higher voltage electrical waves but they are slowed down to 2 or 3 hertz. During coma also very feeble waves are recorded.

The irregular slow waves (one to three per second) that arise from the localized area of brain damage are called delta waves. Rhythmic slow waves at frequencies between 4 and 7 Hertz are called theta waves. Slow waves suggest abnormality in the adults but not in infants or young children. EEG patterns change gradually in the growing child until he has attained the age of 8 to 12 years. That is when the adult patterns appear.

Every person has a different EEG pattern. Identical twins have almost identical patterns.

The EEG has proved to be very useful for studying the working of the brain. It has proved helpful in detecting many brain diseases.

EEG can also give indications about abnormalities of the brain. Epilepsy and abnormal metabolic conditions can be detected through it. 'Coma' conditions can be studied from EEGs. If we get a flat EEG it indicates the 'brain's death'.

What are goose pimples?

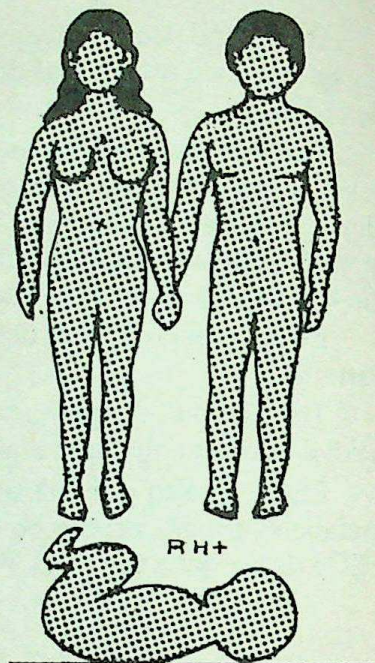
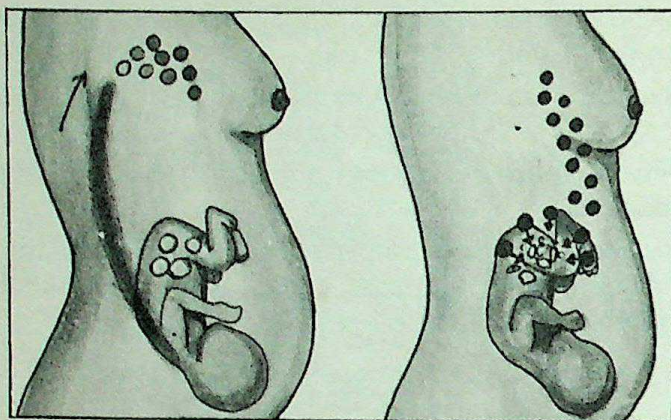
It is a matter of common experience that when we feel cold or frightened, tiny bumps, causing a tingling sensation, appear on our body skin. These tiny bumps, are called goose pimples. Do you know why these occur?

The 'goose pimples' get their name from the actual bumps which appear on a goose's skin when its feathers are plucked.

If you have a close look at the bumps, you will see a hair in the middle of each bump. Attached to each hair inside your skin is a tiny muscle. When you get scared or chilled, messages go shooting off from nerve endings that pick up the feel of cold. In a flash, signals come back to the muscles, and as a result each of these muscles tightens up and gets taut. The skin around each hair is also pulled up. The result is little pumps.

This action of your hair standing on end—actually keeps the outside air nearer to your body and helps to keep it warm in case of chill. If you rub your skin the goose pimple disappears due to the warmth produced by the rubbing.

Cold also makes furry animals' hair rise up. This serves a definite purpose in case of a dog or a squirrel in cold weather. Probably it helped to keep our ancestors warm, millions of years ago when they had more hair on their bodies. Now it is just a reminder of the bygone era when man was also an ape.



What is the Rh factor?

The term 'Rh factor' stands for Rhesus factor. The Rhesus system was discovered by Landsteiner in 1940 while doing research on Rhesus monkeys regarding the blood groups. The Rh (from Rhesus) factor in human blood involves reaction with the blood of Rhesus monkey. In fact it refers to the presence or absence of substances or factors in the red cells. There are half a dozen Rhesus factors but 'D' factor is especially important in this regard. In the majority of people this factor is present and they are known as Rhesus positive or Rh+. But about 15% of the human population, however, inherits—blood that lacks in Rhesus factor. Their Rh factor is thus described as Rhesus negative or Rh-.

There is no naturally occurring anti-Rh antibody. But if by mistake Rh+ blood is transfused into a Rh- person's system, it can stimulate production of an antibody against the foreign 'D' factor and this antibody may eventually destroy the donated cells. The reaction is very slow in first transfusion, but becomes fierce in second or subsequent ones.

The Rh factor plays a significant role during the pregnancy. Some or all of the children of an Rh-negative mother and an Rh-positive father may inherit the factor from the father. When a Rh-mother conceives a Rh+ baby, and the blood supplies of the mother and baby mix during delivery resulting in some of the baby's blood mixing with the mother's blood, her blood may form antibodies against the Rhesus factor. Although these antibodies disappear after a few months, the mother is sensitised. In subsequent pregnancies she may produce anti-Rh bodies which would attack the baby's red cells. As a result the child might be stillborn, or may die at birth with heart failure or with a damaged brain or jaundice.

It is possible to overcome the problem with an exchange transfusion, the gradual removal of the baby's blood, a few millilitres at a time, and its replacement with Rh negative blood. In this way some 95% of affected babies can be saved.

The condition brought about by the Rh incompatibility is known as 'haemolytic disease' of the newborn. The risk has been lessened by the development of a vaccine made from the anti-Rh antibody (known as Rh immune globulin). If this is administered to the mother within 24 hours of the birth of an Rh+ baby, it removes from her blood any Rh+ cells which may have seeped in. This saves her from becoming sensitised.

The vaccine is now given as a preventive measure to Rh-mothers and it is repeated at each pregnancy. Thus because of these precautions the number of deaths from haemolytic disease of the newborn is falling rapidly.

How is the disease of mumps caused?

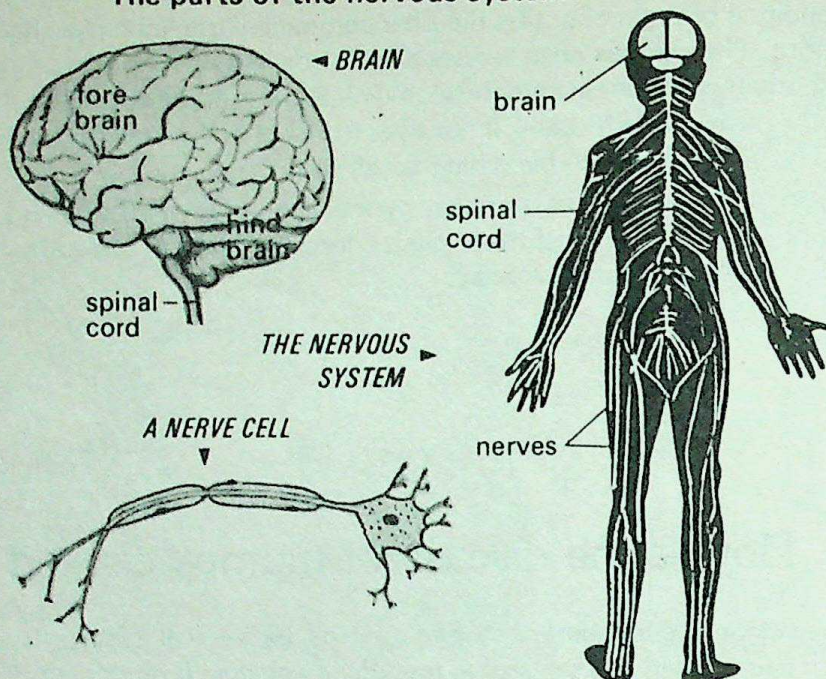
Mumps is a minor physical ailment caused by virus. Its medical name is infectious parotitis. The infection causes pain and swelling in the salivary glands. It often occurs as an epidemic and mainly affects the young persons. Its main symptoms are the swelling and distortion of face. This makes talking and chewing difficult and painful. The name 'mumps' seems to have originated from mumblings produced by afflicted people attempting to talk.

Mumps is probably spread by tiny droplets of moisture let out by people while speaking, coughing or sneezing. The virus in the droplets settles in the mouth and nose of one who breathes it in. It then enters the body and starts multiplying. Then it spreads through the whole body, not just restricted to the salivary glands. The signs of illness may not appear until 18 to 24 days after the infection. This is called the incubation period. When the disease starts the patient develops a high temperature. He may also suffer from headache, sore throat or ache in neck muscles. His salivary glands become tender and swollen. After about four days, the temperature begins to fall and returns to normal. After a week or ten days the swelling of the glands disappears.

In this disease, the other organs of the body are very rarely affected. Among men testes may be affected and among the women ovaries. Normally no damage is done to them. In very rare case the brain's membranes get inflamed. In children, 'mumps' is a mild disease although painful.

Mumps itself requires no special treatment. The use of gamma globulin has tended to reduce the incidence of complications. Its vaccine has also been developed that provides a protection against this disease.

The parts of the nervous system



How does our nervous system function?

The nervous system is a system of nerves involved in passing signals and messages from one part of the body to another. All the animals have special cells to perform this function. These cells are called 'nervous' or 'nerve cells'. The messages are in the form of electric signals or nerve impulses. They travel through the cell and are passed on to other cells. In the animal body there are millions of nerve cells linked together to make up the nervous system. The human brain itself contains about ten thousand million nerve cells.

The human nervous system is divided into two main parts—of which the brain and the spinal cord are the controlling parts. The brain is protected by the tough bones of the skull. The spinal cord is protected by the bones of the spinal column. From the brain and the spinal cord nerves extend to all parts of the body. These nerves are defined as 'the peripheral nervous system'. The brain and the spinal cord are called 'the central nervous system'.

There are two kinds of neurons. Sensory neurons carry messages from distant parts of the body towards the brain. These relate to temperature, pain, pressure and messages from the sense organs. The neurons that carry messages to muscles, telling them to contract and to glands telling them to produce the secretions, are called motor nerves. The nerves of the central and peripheral nervous system are mixture of sensory and motor neurons travelling together.

The nervous system can also be divided on the basis of the neurons' nature of work. In the 'voluntary nervous system', the nerves are all concerned with conscious sensations. They carry out orders given by the brain that are directed by will. When we want to walk, write or talk, it is the neurons of the voluntary system that we use. The neurons of the autonomic system are the ones that help in carrying out the routine activities we don't normally think

about. The autonomic system regulates the heart rate, digestion, blood pressure, and other unconscious activities.

The autonomic nervous system has two main divisions called the sympathetic and parasympathetic systems. Their activities balance one another. Nerve impulses in the sympathetic system tend to increase the heart rate beat and the blood pressure. On the other hand the impulses in the parasympathetic system tend to have the opposite effect. Under different conditions, the each system takes control of the unconscious activities.

With training, it is possible to control some of the autonomic system's activities by will power. However, we are not born with this ability.

What are tranquillizers?

A tranquillizer is a drug that calms a person's mind. It does this without putting one to sleep. Unlike a sedative, it does not induce sleep. However, its tranquillizing effect may put the person to sleep. If given in the right dosages, most depressants and sedatives can act as tranquillizers.

The first member of the tranquillizer drug family was phenothiazine. This was first synthesized in the 1880s, but its potentiality remained unrecognised for nearly 70 years. In 1950 French researchers synthesized the first widely-used tranquillizer, chlorpromazine. Chlorpromazine and allied drugs lower the activity in certain areas of the brain that are concerned with emotions, such as the cortex, thalamus and hypothalamus. They also have a sedative effect. The benzodiazepine drugs produce a lighter tranquillizing effect and include valium and librium.

The tranquillizers are being used for many mental illnesses such as schizophrenia and anxiety neuroses. Chlorpromazine has been used especially in the treatment of schizophrenia.

The tranquillizers are taken through mouth and enter all the body tissues. How exactly the tranquillizers work is still not very clear to the medicalmen. They are believed to affect transmission of nerve signals between certain nerve cells in the brain. Their side-effects include drowsiness and tendency to low blood pressure. They may also affect the liver, producing jaundice or cause skin rashes.

Doctors give tranquillizers to relieve nervous tension or to reduce high blood pressure. If used in large doses for a long period of time these drugs can cause addiction.

How is sunshine healthful for us?

We generally know that sunshine is somehow good for our health. In fact, there are specific scientific reasons to prove this fact. Do you know what happens to our body when we expose it to the sunrays?

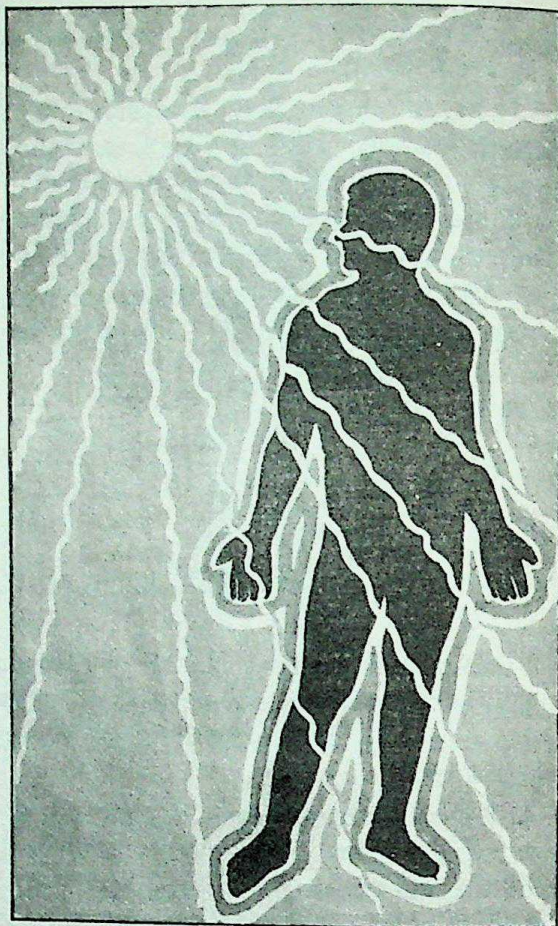
Sunlight actually destroys certain particular fungi and bacteria that may have settled on our skin. In this regard it has a strong medicinal value. Another way in which sunshine acts as a protective agent is by further activating the white blood cells. We know that these cells attack disease germs in our body and help us keep healthy. Thus sunlight helps us to develop a greater resistance to fight diseases.

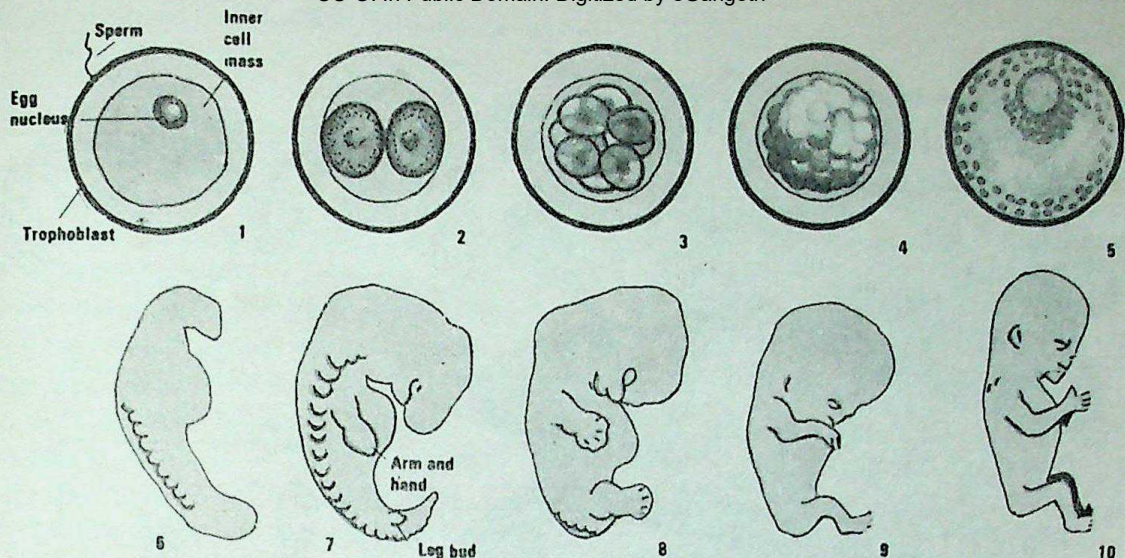
When sunlight falls on the skin, it causes certain substances to move into the blood and give the muscles a new tone. The muscles become more tense and thus can work better. In fact, our nervous system gets a kind of "charge" from sunlight and thus we feel stimulated and want to move about.

There is a substance in the skin called ergosterol that is transformed into vitamin D by sun's ultraviolet rays. This vitamin is very useful for bones.

These are some of the reasons why exposing ourselves to the sunrays is useful. In fact it's just like swallowing a teaspoonful of medicine every five minutes. But it is important to remember that this "medicine" is by no means harmless. We have to be just as careful about sun-bathing as we would have to be about taking medicine.

Sun-bathing raises the blood pressure, so people who have heart trouble or certain lung diseases run the risk of physical harm by excessive exposure to sun. In fact, every one should expose himself to sunlight only in phases. For instance, while taking sun-baths the best thing is to begin by exposing one-fifth of the body for about five minutes. The next day, expose another one-fifth of the body for an extra five minutes, and so on. In this way one can get all the benefits of sunlight without running into unnecessary risk.





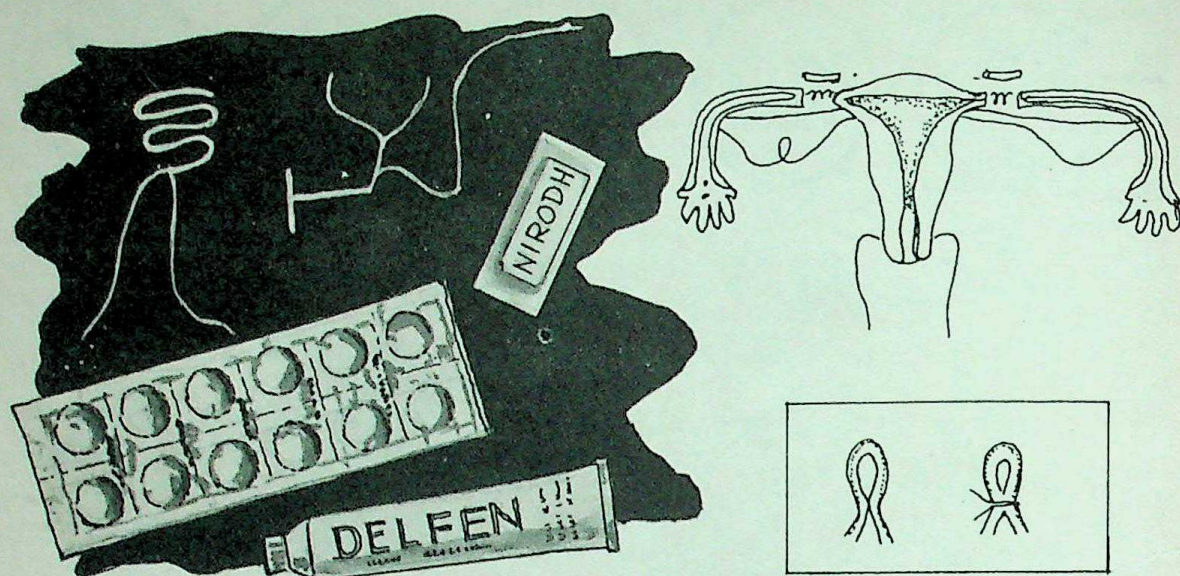
How does a fertilized egg cell become a complete human being?

To begin with, a fertilized egg (or zygote) is of the size of the head of a pin. It is formed by the union of the male and female sex cells, the ovum and sperm. It settles inside a specific place in the mother's body called the uterus. Almost immediately after it is formed, the zygote begins to divide and in less than 30 hours forms two cells, called blastomers. These two cells are absolutely alike. The repeated cell division, rapidly increase the number of blastomers. But then all these cells are not alike. Some are muscle cells, some others bone cells, nerve cells, blood cells and so on. In short, all the different kinds of cells that make up a human body are present.

About two weeks after the fertilized egg began to divide, the new cells start forming special body parts—the brain, heart and lungs etc. After about two months, the developing baby comes to have eyes, ears, a nose and a mouth. By this time it even has tiny legs and arms. It has a complete heart that beats and sends blood through its body. But it is surprising to note that even at this stage it is less than an inch long, and weighs about one gram. Now its major function is to grow. At this stage it is called 'foetus'.

For seven more months, the baby keeps developing in its mother's body. The foetus grows at the rate of about 1.5 mm each day, doubling its length during the third month. It reaches almost half of its full-term length by the end of fifth month i.e. 25 cm (10 inches).

The weight gain begins in the seventh month when ordinary white fat gets deposited under the skin, all over the body. In addition to this, during the last few weeks in the womb, special form of fat, called the brown fat, gets deposited across the shoulders and at other places on the upper body. By the end of the nine months (the normal pregnancy period) the foetus would probably weigh somewhere between 3 and 4 kg, and be about 50 cm (20 inches) long. Thus finally the baby is born.



What is birth control?

When a sperm cell from a man's body fertilizes an egg cell in a woman's body, she becomes pregnant. A baby begins to grow inside her. If a man and a woman want to keep this from happening, they can use birth control or contraception.

The contraception is used by couples who wish to prevent pregnancy. There are many ways in which pregnancy can be effectively prevented. These methods can be broadly categorized into five classes: (i) the natural methods, (ii) barrier methods (iii) intra-uterine devices (iv) oral contraceptives and (v) sterilization.

(i) Natural Methods : The two natural methods of birth control are the rhythm or safe period method and coitus interruptus. For women who have regular 28 day menstrual cycles, abstinence from intercourse three days before and three days after the predicted time of ovulation (14 days after the onset of menses) may prove a successful method of birth control. However, If a woman's cycles do not occur with complete regularity and vary from say 26 to 31 days, only 12 to 18 days per cycle should be avoided for intercourse.

The second natural method, coitus interruptus, involves interrupting sexual intercourse before the man ejaculates. This method is however, very risky.

(ii) Barrier Methods : Barrier contraceptives are those which prevent the viable sperm either from entering the vagina or from reaching the uterus, leaving them unable to 'swim' up the fallopian tubes and fertilize an ovum. They include use of the male sheath or condom, the female diaphragm and vaginal chemical contraceptives. The use of condoms is a reliable method of birth control. It prevents sperms from entering the vagina. The diaphragm is also uterus. Vaginal chemical contraceptives include some creams and jellies which immobilize or destroy sperms.

(iii) Intra-Uterine devices : An almost infinite variety of intra-uterine devices are now available in different parts of the world. These are rings, loops, spirals, coils, dalkom shields, copper 'T' etc. These devices are inserted into the uterine cavity. Some of the major drawbacks of these devices are unpleasant side-effects such as bleeding, pain and infection.

(iv) Oral Contraceptives : The oral contraceptives are birth control pills which keep the egg from moving out of woman's ovary and thus prevent her from becoming pregnant. These pills contain oestrogen and progesterone hormones. When a pill is taken for 21 days of the menstrual cycle, the oestrogen and progesterone are maintained at a constant high level, and as a result ovulation is not triggered and without an ovum, pregnancy cannot occur.

(v) Sterilization : It is an extremely effective method of contraception because it is permanent. It can be performed by a surgeon on either man or woman. In man, the sperms are prevented from leaving the testes by cutting and tying the vas deferens. In woman, the surgeon closes the fallopian tubes along which the egg cells pass in order to reach uterus.

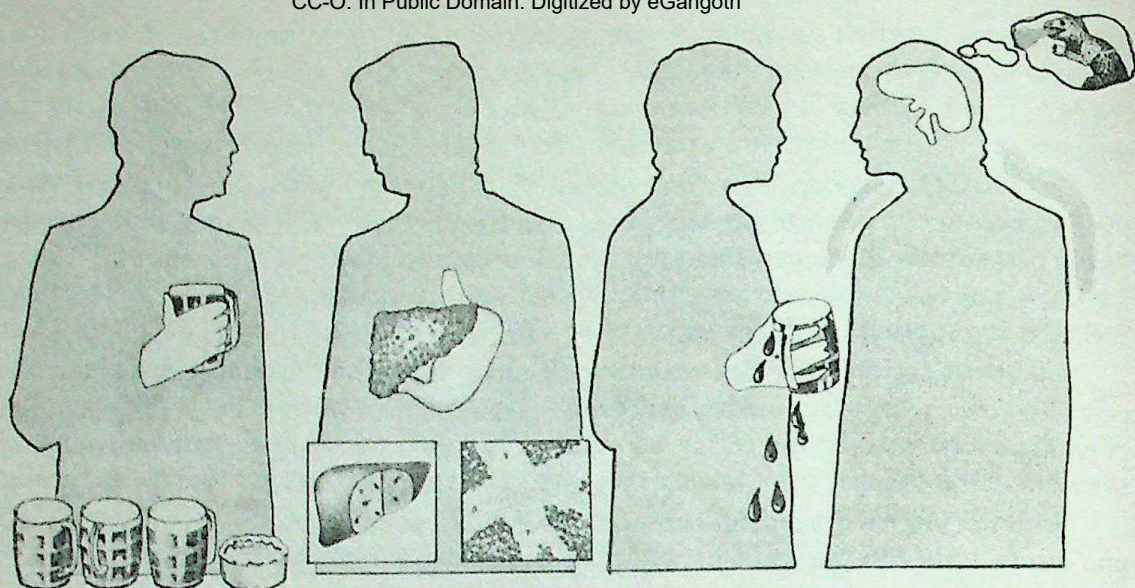
With the help of the different contraceptive methods one can have as many children as one wants. One can give gaps between the births according to one's wish.

What is Electroshock Therapy?

The electroshock therapy is a method of treating certain psychiatric disorders through the use of electric current to induce shock. This therapy, is generally used in treating severe endogenous depressions and some forms of schizophrenia. How this therapy achieves its effects is still not clear?

The electroconvulsive therapy was introduced in Rome in 1938 by U. Cerletti and L. Bini for treating psychiatric disorders. After that it has been widely used to treat manic-depressive psychosis and various other types of depression. In the electroshock therapy, two electrodes are placed in appropriate positions on the head of the patient and 50 or 60 Hertz alternating current at about 70 volts is passed for about 0.1 sec. There have been modifications and variations of this basic technique. The passage of the current causes an immediate cessation of consciousness, and the induction of a convulsive seizure. The electroconvulsive treatment is given three times a week for a period ranging from two to six weeks. In some serious cases, however, the doctors resort to even two or three treatments in a single day.

The electroshock therapy can have serious side-effects and complications. Therefore it is to be used only for certain selected patients, and with great skill and proper judgement. Although, it is a valuable therapeutic method in psychiatry, in certain cases it has no effect and sometimes even makes matters worse.



What is liver Cirrhosis?

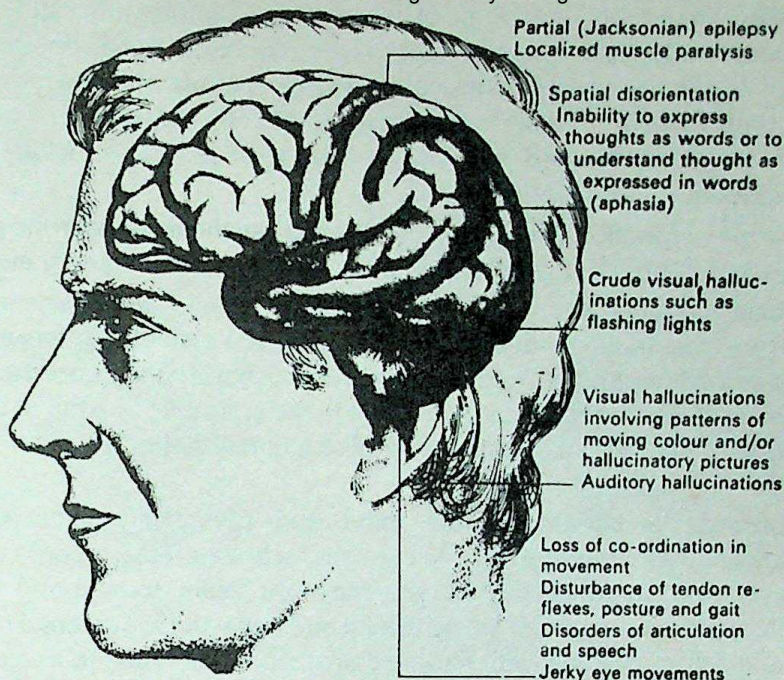
Cirrhosis is a liver disease which renders a part of spongy liver tissue scarred and useless. It can be caused by excessive alcohol consumption, poor diet, poisonous fumes, hepatitis, or inflammation of the liver. Once liver tissue gets scarred, it cannot be repaired. As a result the liver may become useless and stop making proteins and purifying the blood.

The commonest type of cirrhosis is known as Laennec's cirrhosis. Although it can occur at any age, usually it mainly affects the people between 40-60 years of age. It is more commonly found among the males than the females. To begin with this involves an abnormal increase in liver fat. Soon the liver starts degenerating, and in the end only a little fat is left.

The cirrhosis can block the blood vessels to the liver and cause internal bleeding. Many people afflicted by cirrhosis become weak and lose weight: In certain cases the abdomen gets swollen with excess body fluids. The patient skin and eyes may become yellow.

The cirrhosis is of several types. Postnecrotic cirrhosis is caused by viral infection of the toxins. The pigmentary cirrhosis occurs when the iron deposition in the liver cells crosses the normal level because of a blood disorder, too much iron in the ducts, or an accumulation of iron from blood transfusions. In Wilson's disease, the copper present in the liver becomes in excess. The Syphilitic cirrhosis is indicated by large, soft lesions in the liver which erode the tissue and eventually leave masses of scarred tissues and fissures.

The cirrhosis may give rise to high blood pressure in the portal vein that can lead to hemorrhages in the spleen, liver, esophagus or intestines. The disease can be treated in the early stages by drugs, proper diet and by avoiding alcohol. If not controlled, cirrhosis can lead to coma and eventually death.



What are the different mental illnesses?

A mental illness means the sickness of the mind and like the other sick persons, the mentally ill need special treatment. Mental health includes the prevention of mental and emotional disorders and, the detection, treatment and rehabilitation of the mentally ill.

Mental illnesses are of two types—organic and functional. Organic mental illness is caused by damage to the brain. The cause can be high fever, an accident or a change in the amount of hormones the body produces.

There are many types of organic mental illnesses. Epilepsy is a disease caused by a damaged brain, but it can occur even among perfectly normal people. In the latter case it is called idiopathic epilepsy and may be due to some microscopic scar in the brain tissue. In the case of brain haemorrhage and thrombosis, the brain's blood supply is damaged. Cerebral palsy and spastic paralysis are caused by brain damage in childhood. Multiple sclerosis involves a damage to brain tissue. Parkinson's disease is caused by a disorder of brain chemistry. Other organic mental disorders are caused by brain injury. Amnesia is the loss of memory. Aphasia is a serious disorder of thought and communication.

Most of the mental illnesses are functional disorders. In a functional disorder, a person's mind is ill without any apparent damage to the brain. These disorders fall under two main groups. The most common one is neurosis. It is a mild emotional disorder. A neurotic person's thoughts or actions can upset his relations with other people or make him unhappy.

There are several common types of neuroses. They include anxiety states, hysterical reactions and obsessive compulsive disorders. The anxiety neurosis may lead to abnormal fear or dread of death or of certain places or people. This fear in some cases called a phobia,

could seriously disturb a person's life. Some of its common examples are: claustrophobia (the fear of closed spaces) and acrophobia (the fear of heights). Hysteria has physical symptoms, such as paralysis without an apparent physical cause. The people with obsessive-compulsive neurosis have a compulsive urge to perform certain acts. They may spend much of their time performing the same acts over and over again. Character neuroses include passiveness, aggressiveness, moodiness and elation.

The second type of functional disorder is termed as psychosis. A neurotic person knows what is real and what is not. But a psychotic person may think imaginary events as real.

The psychosis illnesses are mainly of two types: manic-depressive psychosis and schizophrenia psychosis. In manic-depressive psychosis, the patient may feel excited, elated, miserable, gloomy or without hope. Manic-depressive psychosis can be cured or relieved with drugs. This suggests that certain chemical changes in the brain may be a major cause for this illness. But depression may also be a psychological reaction to a shock such as the death of a close friend.

In schizophrenia, a person's whole mind and personality becomes disrupted. Schizophrenia means, "splitting of mind". In catatonic schizophrenia, a person may become completely inactive and immobile. He or she may not seem to respond to reality. In hebephrenic schizophrenia, a person starts talking and behaving in a strange manner. He or she may behave childishly. People with paranoid schizophrenia come to imagine that other persons wish to persecute them and they behave accordingly.

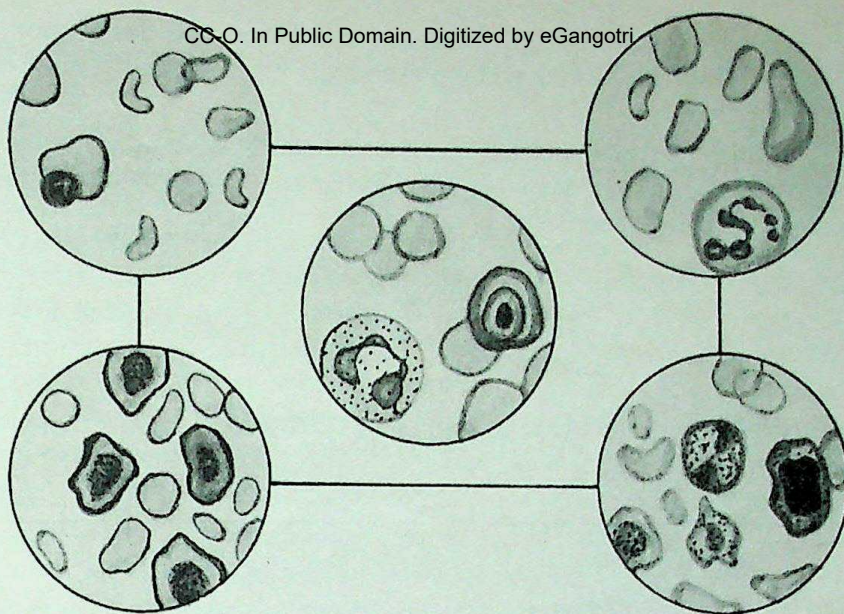
The experts may differ in their treatment of mental illnesses. The medical doctors that specialize in mental illnesses are called psychiatrists. Therapies which are used to treat mental illnesses are called psychotherapy, group and behaviour therapy, drug therapy and electroconvulsive therapy.

Why do we shiver on a cold day?

It's a matter of common experience that if we aren't wearing anything woollen on a winter day we start shivering. And if we want to stop it we cannot do much about it. Do you know why do we shiver on a cold day?

Physiologically speaking, the shivering is the automatic movement of the muscles. When we shiver our muscles tighten and relax very quickly over and over again. Each time when our muscles contract, the muscle cells burn more food for energy, and as a result of this, heat is produced. Thus shivering is a mechanism of the body which helps to keep it warm. It keeps the body temperature from falling beyond a certain point. This is a process in which our muscles work hard and keep the body warm.

So, if we do some exercise, play ball or run on a cold day, we wouldn't shiver. By exercising, we make our muscles to do hard work. The exercise warms up the body. Shivering in fact does the same job without any exercise.



What is Anemia?

Anemia is a particular physical condition in which the amount of hemoglobin or number of red blood cells in a person falls below the normal level. In fact the hemoglobin is a protein containing iron. It is carried in the red blood cells of human blood and imparts it the red colour. Hemoglobin makes it possible for the blood to carry oxygen. In every healthy human being, the hemoglobin maintains a certain level of concentration. The mean values of hemoglobin for males are 15 gms per decilitre and for females 13.5 gms per decilitre. Values which are less than 2.5 or 3 standard deviations below the mean are indicative of anemia. The mean values are greater for adult males than for the females, and again greater in adults as compared to the children.

To detect anemia, the concentration of three things in the blood is measured. These are: the hemoglobin, the red-cell count and hematocrit. If the values of these things are below the normal level, the person is said to be anemic.

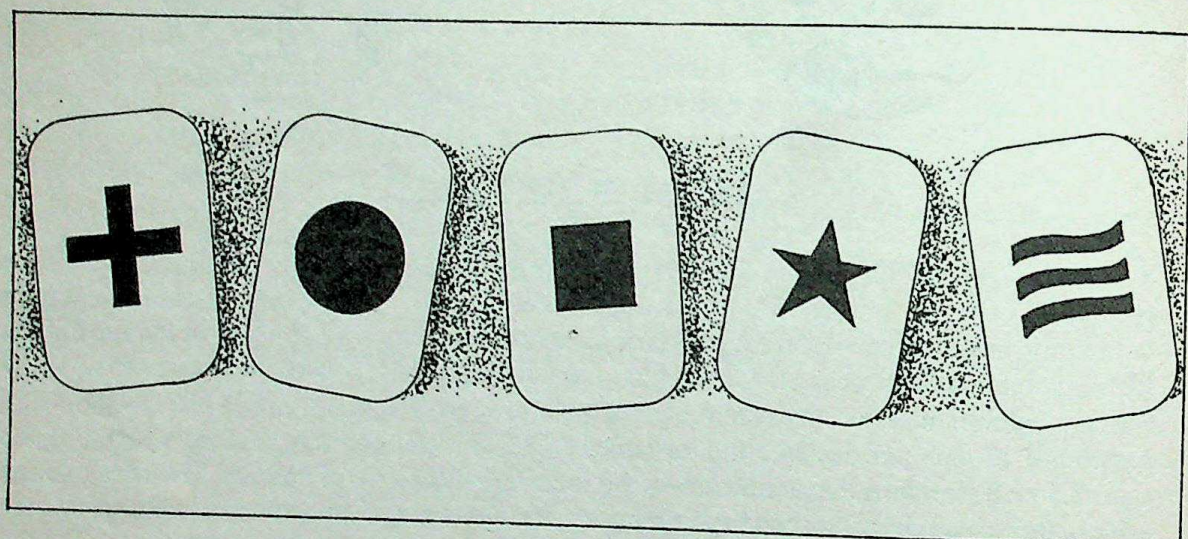
This disease may have several causes. The major ones are: (i) defective blood formation, (ii) cell destruction and (iii) extensive loss of blood. Moreover there are a number of physical disorders, any of which can cause different types of anemia. Some of the specific types of anemia are: (i) microcytic anemia (red cells are smaller than the normal size) (ii) macrocytic anemia (red cells are larger than the normal size) (iii) normocytic anemia (red cells are of normal size) and (iv) hypochromic anemia (cells contain very little hemoglobin). Anemia resulting from sudden blood loss are generally normocytic in nature.

Red cells have an average life-span of 120 days in the circulation. Each day about 45000 red cells per microlitre are removed from the blood circulation in a healthy person. They are replaced with new cells from the bone marrow. Anemia occurs when this rate of removal of red cells from the circulation exceeds the replacement or when the production of red cells is impaired or is ineffective in delivering cells to the circulation.

The anemia which results from increased red blood cell destruction is known as hemolytic anemia. This may be caused by poisoning, a kind of malaria, poor diet, allergy or some heredity condition.

A common form of iron-deficiency anemia is seen in a common occurrence among women, specially during pregnancy since the mother has to supply iron to her baby in the womb. Excessively heavy periods can also cause the problem.

What is the ESP?



By ESP the scientists mean 'extrasensory perception'. In other words it means, 'awareness outside the senses'. Usually we use our five senses—eyes, ears, tongue, nose and skin to perceive the world around us. We see, hear, taste, smell and feel with the help of these sense organs. The ESP means getting certain information about the world without using any of the five senses. Some examples of the ESP include reading someone's mind, knowing the future, or the knowledge of something happening many miles away. Some people seem to have such special powers.

As yet the scientists have not been able to prove anything substantial regarding the ESP. If it exists, they don't know how it works. Most of the scientists believe that it is best to think of ESP as something that might be true, but has not been proved beyond doubt.

There are four basic areas of experiments in the field of extrasensory perception. These experiments involved telepathy, clairvoyance, precognition and psychokinesis. The ESP researchers use a special deck of cards. This deck is made up of 25 cards with certain symbols such as a cross, a circle, a star, wavy lines and a square etc; (see the fig above). At the Duke

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University (North Carolina) Professor J.B. Rhine has been carrying on experiments on it for the last 25 years.

In the telepathy experiments, a person tries to "read the mind" of the one conducting the experiment by guessing the cards. Telepathy involves sending of thoughts, feelings or knowledge from one person to another without any apparent medium.

The clairvoyance is the state of being mentally aware of something such as an event or a person, without the telepathic help from any other person. In the clairvoyance tests, a person identifies cards through various methods without seeing them. When the number of correct guesses is higher than the average person achieves, it suggests that the person has extrasensory perception.

The precognition is the knowledge of event, by means of telepathy or clairvoyance before it takes place. In the precognition tests, by using cards or dice an attempt is made to predict a sequence of events before they occur.

The psychokinesis is the psychological control of physical objects. For example, while tossing the coin, a person might concentrate on the 'heads' and cause it to appear.

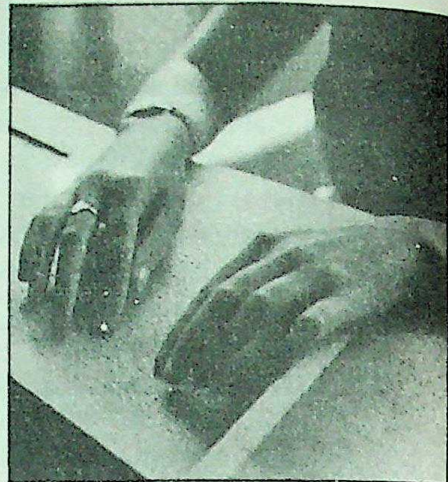
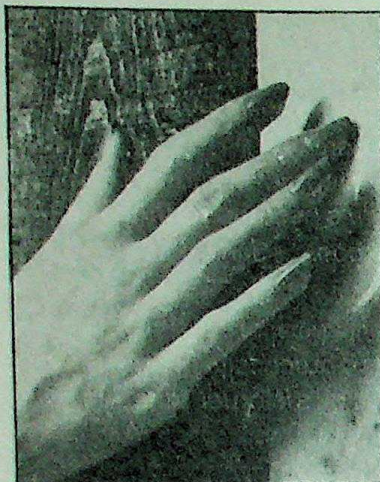
The scientists have been studying this phenomenon because they feel it has enormous potential. For example, a person with ESP abilities might be able to predict future wars, locate valuable mineral deposits or even accomplish other things of great importance.

Why do we have a belly button?

We all have a belly button. It is a little dent in the belly. Do you know what it is?

Before the birth, a child passes through embryo and foetus stages. In these stages his abdomen is connected to the mother's body by a rope-like tube called the umbilical cord. Everything which an embryo or a foetus needs to survive and grow during the nine months of pregnancy before birth is supplied to him from mother's body through this cord. Oxygen and food from mother's blood goes to it through the vein in the umbilical cord. And the wastes are excreted through the two arteries in the umbilical cord. The cord remains attached to the spot where the belly button is.

After the child is born, umbilical cord is no longer needed because the child can now eat, drink, breathe and get rid of body's wastes by himself. So the doctor who performs the delivery, carefully cuts it off as close to belly as possible. It does not hurt the mother or baby. A tiny piece of cord left after cutting dries within a week and falls off. A scar or a dent is left on the abdomen. It is called navel or belly button.



What is the sense of touch?

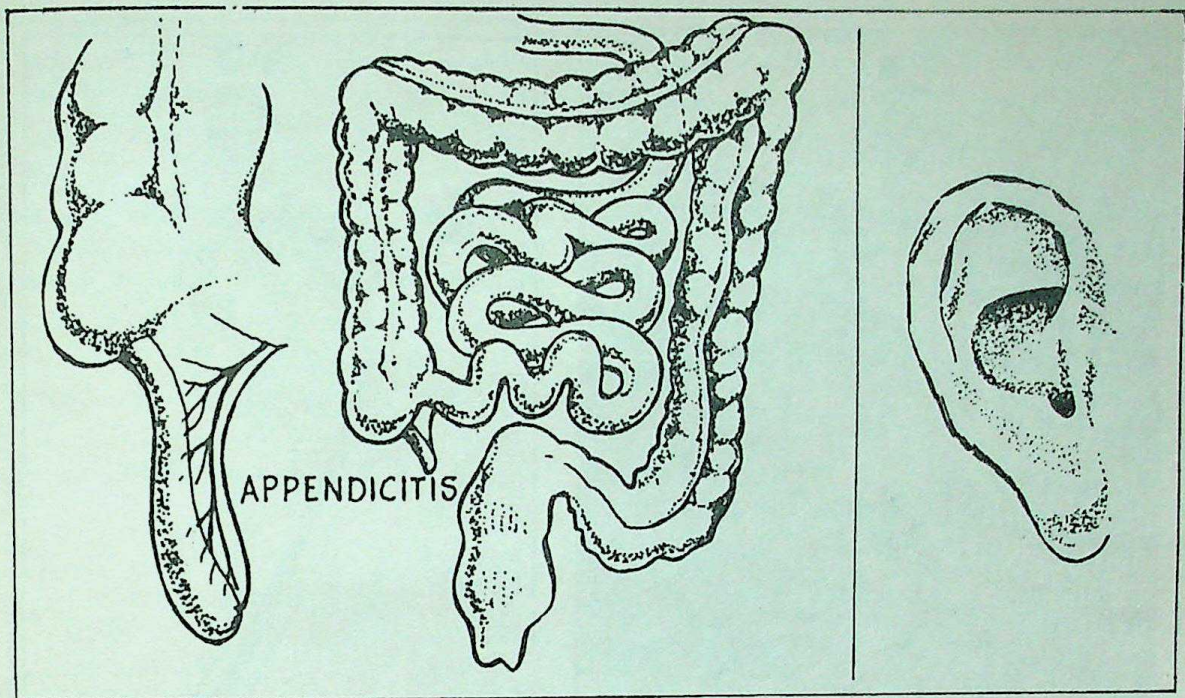
The sense of touch is one of the five senses in body, and helps us to feel the physical contact with other objects. It, in fact, includes distinct sensory perception all of which respond to stimuli applied to the skin. It is called a tactile sense. Through touch, we can learn about the shape and hardness of an object and experience warmth, cold, pain and pressure.

There are several types of touch organs called tactile corpuscles in the skin and mucous membranes. According to one theory, five different types of nerve endings, said to respond to the stimuli of different sensory modalities, have been differentiated as: pain-free nerve endings; pressure-pacinian corpuscles; cold-krausse end bulbs, heat-Ruffini endings and touch-Merckels discs and Meissner corpuscles. It was found through further experiments that some of these sense organs in the skin respond to more than one type of stimulation.

The touch organs are found near hair, in areas without hair and in deeper tissue, the sensation of touch occurs when an object comes in contact with the sense organs and presses them out of shape, or when it touches a nearby hair. The nerves carry impulses from these touch organs to the spinal cord, and from there to the brain.

The touch is more sensitive in some parts of the body than in other parts. This is because the sense organs are not distributed evenly throughout the body. At some places, these sense organs are found in the clusters. The tip of the tongue, of the fingers and the end of the nose are extremely sensitive areas mainly because of the cluster of sense organs present. On the other hand, the back between the shoulder blades contains only a few sense organs per square centimetre. That is why these parts are less sensitive to the outside stimuli. The sense organs sensitive to warmth, cold or pain, are also distributed unevenly. Some objects act upon the external stimuli at once. For example, a hot iron would cause pain and heat anywhere in the body.

There are several million points on the body that register either cold, pain, heat or touch. Doctors can map up these points for any given area on a person's skin.



Which are the vestigial organs in our body?

We have a general impression that every organ in our body has one or the other function. But this is not true. There are certain structures in our body which are practically of no use. Such organs are known as vestigial organs. Do you know what these vestigial organs are and how they became useless in the body?

The human body has more than 100 organs which are of no use today. They might have been essential for the body at one time, but in course of time they have become redundant. Some of the vestigial organs in our body are: the appendix, fused tail vertebrae, wisdom teeth, muscles that wiggle the ears, nictitating membrane, nipples on male etc.

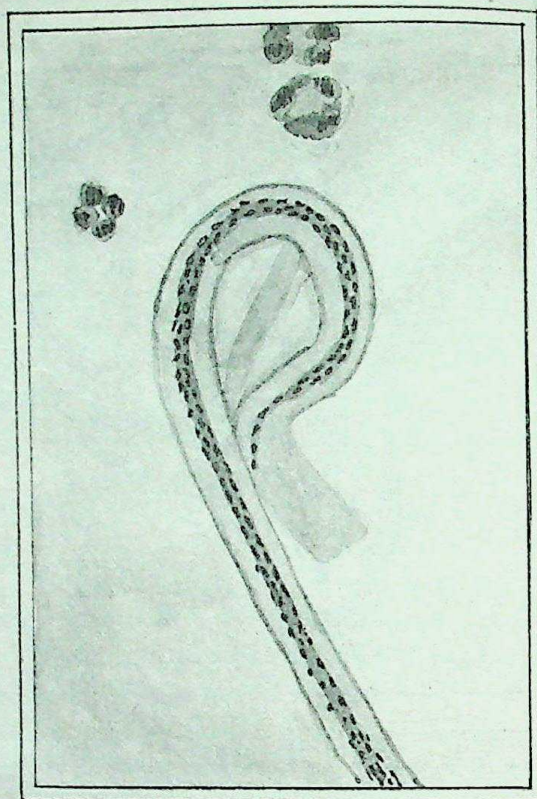
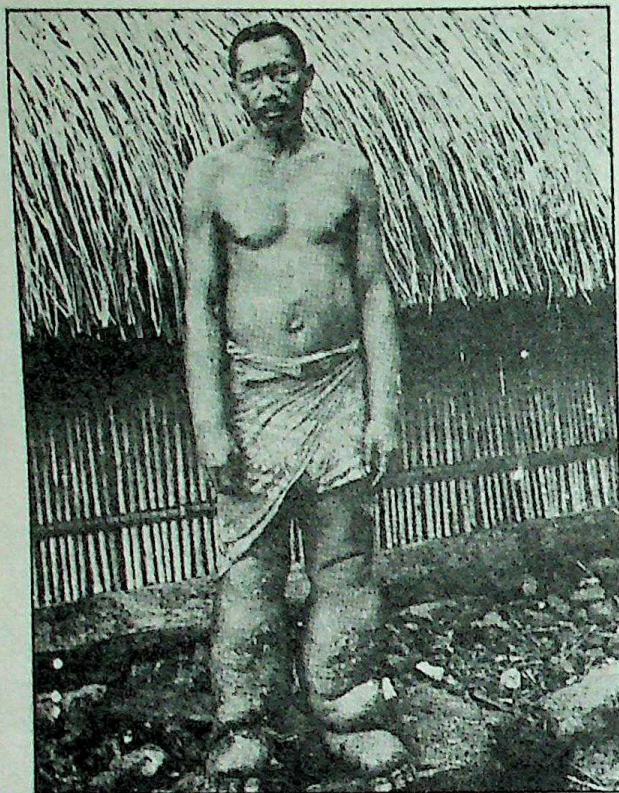
Their presence suggests they existed in the ancestral forms and were important for certain functions. But in some forms they lost their utility and became non-functional. Do you know how they became redundant?

In the course of evolution, animals and plants tend to undergo adaptive morphological changes that enable them to survive under certain conditions. There is a constant change occurring which may cause a decrease in size and function of an organ. Again the change in the environment may make an organ unnecessary for survival. As a result many plants and animals today contain organs or parts that are useless, degenerate and undersized for them.

The organs which have become redundant for human beings are still useful for other animals. For example, the ear muscles are used by a large number of animals for moving ears. Nictitating membrane is used to protect the eye in aquatic vertebrate, vermiform appendix is used for digestion of cellulose in some herbivores and so on.

Study of vestigial organs provides significant evidence in support of the theory of organic evolution.

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What is Filariasis?

Filariasis is a name given to a group of infectious diseases caused by one or more species of thread-like worms called nematodes. Nematodes are parasitic worms. Some of them are so small that they can only be seen with the help of a microscope. Most of them grow 1 mm to 5 cm long. A nematode's body is usually pointed at both ends. Males are smaller than the females.

Some nematodes live in soil and water. Many, such as the eelworm, live as parasites in plants. Hookworms, lungworms, pinworms, trichinellas and filarias live as parasites in human beings. They also live in dogs, sheep and horses.

Parasites of filaria invade the subcutaneous tissues and lymphatics of man and produce acute inflammation.

Nematode lifecycle requires two hosts, an arthropod (the intermediate host) and one other animal (the primary host). The larval phase occurs within the body of a biting insect and the mature phase in the body of an animal bitten by the insect.

In the human body, the female worm gives birth to elongated embryos, the microfilariae, that pass into the peripheral blood and skin. These then enter the body of an insect as the insect bites the infected person. Within the insect carrier, the microfilariae grow into larvae and are then introduced into the human host by the insect bite. In the human body they reach maturity in about a year.

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The human disease, filariasis, is caused by various species of filarial worms, especially by *wuchereria bancrofti*. These organisms are widely distributed in tropical and subtropical regions of the world and are transmitted to man by mosquitoes, usually *Culex fatigans*. The worm causes inflammation and thickening of the tissues in which it settles, particularly the skin and lymphatic tissues.

The initial inflammatory stage is characterised by granular lesions, swelling and impaired circulation. This stage is followed by enlargement of the lymph nodes and dilation of the lymph channels, which over the years harden and get clogged. The legs and scrotum tissues expand considerably. This condition is known as Elephantiasis.

The most effective drugs for these disorders are diethylcarbamazine and sodium caparsolate which kill the adult worms and microfilariae.

Filariasis occurs along the Mediterranean coast, in Arabia, Asia, Indonesia and the islands of the South Pacific.

What are the stones of kidney and gall bladder?

We often hear of people getting stones in their kidneys or gall bladders. These stones vary in size from a pin-head to the size of an egg. In general small stones are formed in the kidney and the larger ones in the bladder. In some cases smaller stones pass out of the ureter with urine, while the larger ones can only be removed by surgery. Do you know what these stones are and how they are formed?

In scientific terminology these stones are called calculi. Most of the calculi contain uric acid, urates, calcium oxalate and phosphates. The last two are very common. Most stones consist of an arrangement of concentric rings around a central nucleus. Uric acid stones do not allow the X-rays to pass through and so can be detected with their help. Five to eight percent stones are of this type. They are usually coloured having varying shades of brown. They are smooth and hard.

Calcium oxalate stones are formed mainly in men. This type of stones contain some amount of phosphate also. These are the hardest stones. They are usually rough and oval shaped. Phosphate stones contain calcium, sodium and potassium. They are usually formed in the gall bladder and mainly in women. These stones grow to a larger size. They are also opaque to the X-rays.

The mechanism of stone formation has not been understood fully so far. It is believed that stagnation of urine, particularly if there is infection in the urinary tract, may lead to stone formation.

When urine is slightly acidic i.e. at pH 6 compound calculi of sodium urate, uric acid, calcium phosphate and oxalate are usually formed. When urine is slightly basic i.e. at pH between 7 and 8, stone of calcium phosphate, magnesium ammonium phosphate and

ammonium urate are formed. Immobility is also a cause of stone formation. Clumps of bacteria, epithelial and pus cells may also act as foreign body nuclei for the stone formation.

In order to avoid stone formation one should consume lot of water. Exercise and movement of the body are also important. The diet should not have too much oxalates and phosphates. These protective methods however, don't guarantee an immunity against stones.

What is the function of spleen in the body?

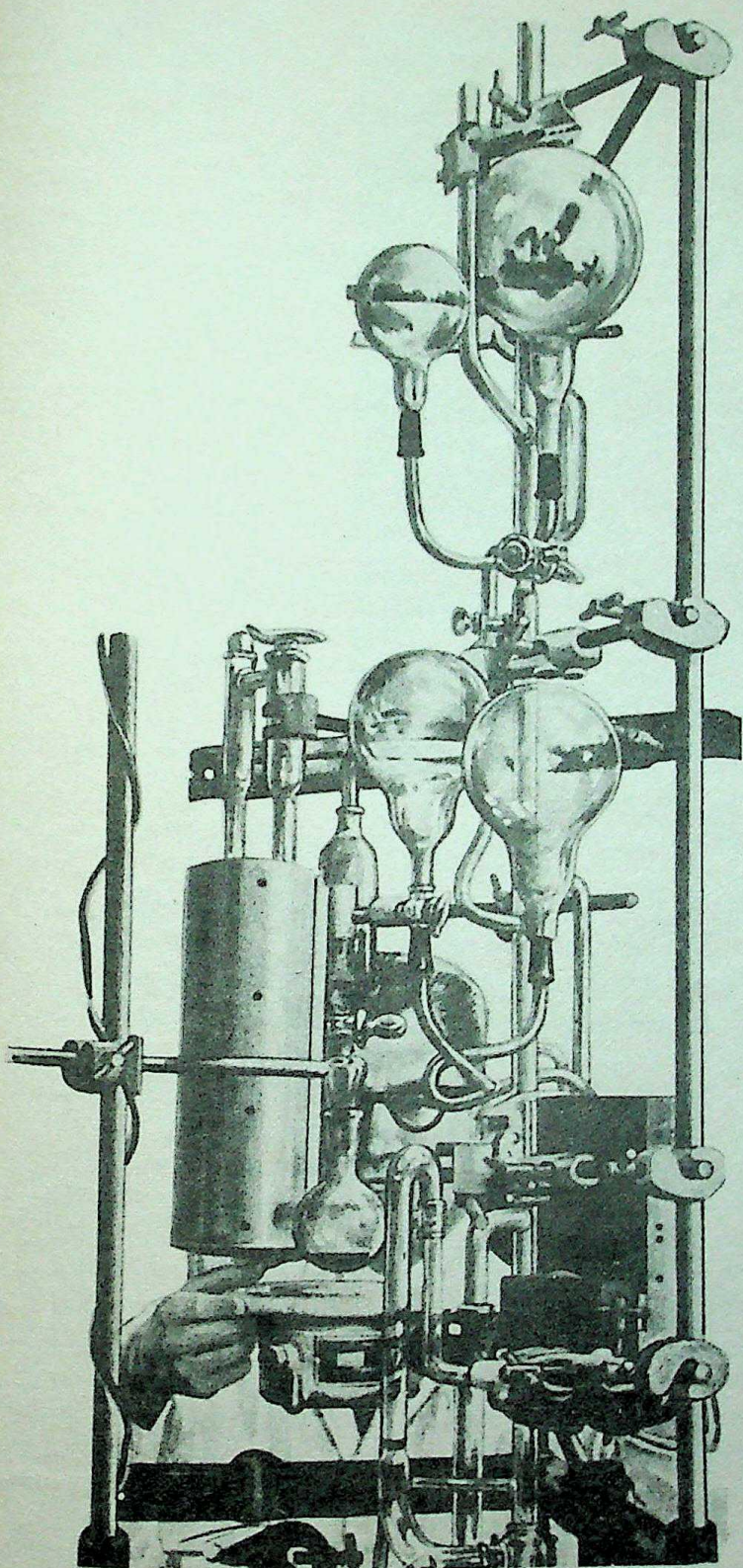
The spleen is a lymphoid organ located in the left side of the abdominal cavity under the diaphragm. It is the primary filtering element for the blood. In an adult, it is about 12.5 cm (5 inch) long and 7.5 cm to 10 cm (3 to 4 inch) wide. The spleen weigh about 200 gm. It is encased in a thick connective-tissue capsule. Inside, the mass of splenic tissue is of two types, the red pulp and the white pulp. These are intermingled and distributed throughout the spleen. The white pulp is lymphoid tissue and the red pulp is a network of channels filled with blood. Most of the filtration occurs in the red pulp.

The white pulp of the spleen reacts to microorganisms and other antigens that reach the blood stream. Phagocytic cells in both red and white pulp serve to remove foreign material from the blood and initiate an immunity reaction that results in the production of antibodies.

The red pulp has a specialized role in addition to filtration. It is here that the major destruction of old and worn-out red blood cells takes place. The life-span of a red cell is about 120 days. In a healthy human being about ten million red blood cells are destroyed every second. Surplus red cells that might be needed in an emergency are stored in the spleen. Therefore it also acts as a reservoir for blood and releases some of the blood when the body looses it through a hemorrhage etc.

Spleen also manufactures white blood cells called monocyte.

The most interesting fact about the spleen is that if it becomes diseased it can be removed from the body by surgery and its vital functions are taken over by other parts of body. Sometimes when spleen becomes diseased, it has to be surgically removed from the body.



SCIENTISTS AND INVENTIONS



What was discovered by Enrico Fermi?

Enrico Fermi was a great Italian-American theoretical physicist. He was one of the chief architects of the nuclear physics. He was awarded the Nobel Prize for Physics in 1938 for his outstanding discovery of Neutron-induced nuclear reactions.

Fermi was born in Rome on 29th September 1901. He was a brilliant student and obtained his doctorate in Physics from the University of Pisa at the age of 21. His research was on x-rays.

In 1926 Fermi became a full professor of theoretical physics at the University of Rome. In 1929, he was elected a member of the Italian Academy. In 1934 he succeeded in making a fundamental discovery in the field of physics. This was the result of 10 years of arduous research. He discovered that when elements are bombarded with slow neutrons, the material becomes radioactive and begins to emit radiation. In this process the element changes into a different material. For example, iron, when made artificially radioactive by neutron bombardment, turned into manganese. In this way Fermi found about 80 new artificial nuclei.

About this time, Italy, under Mussolini, was in the grip of Fascist government. This affected Fermi directly because his wife was a Jewish. So he wanted to leave Italy. Fortunately at this time (in 1938) he was named for Nobel Prize. He was given permission to go to Sweden to receive the award. Fermi left Italy with his family never to return. After receiving the award, he went to U.S. and became a citizen of United States in 1944. There he became Professor for Nuclear Studies at Columbia University in 1939.

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He worked there on controlled nuclear chain reactions. In 1942, after several years of work, he designed and operated the first nuclear-power reactor. His work on the self-sustained chain reactions was utilized in making the first atomic bomb during World War II. This bomb was tested on 16th July 1945. Today these Nuclear power reactors are used to generate electricity.

Fermi, in the recognition of his scientific achievements, received the Medal of Merit of the Congress of the United States on 19th March 1946. He died on 28 November 1954 at the age of 53. A chemical element called Fermium has been named after him. An award called 'Fermi Award' was instituted in his honour and is awarded every year for outstanding work in science.

How S.N. Bose's name became associated with Einstein?

A student of mathematics knows about Bose-Einstein statistics. This was a new type of quantum statistics developed by the National Professor of India, Satyendra Nath Bose. The particles to which this statistics is applicable are named after him as Bosons.

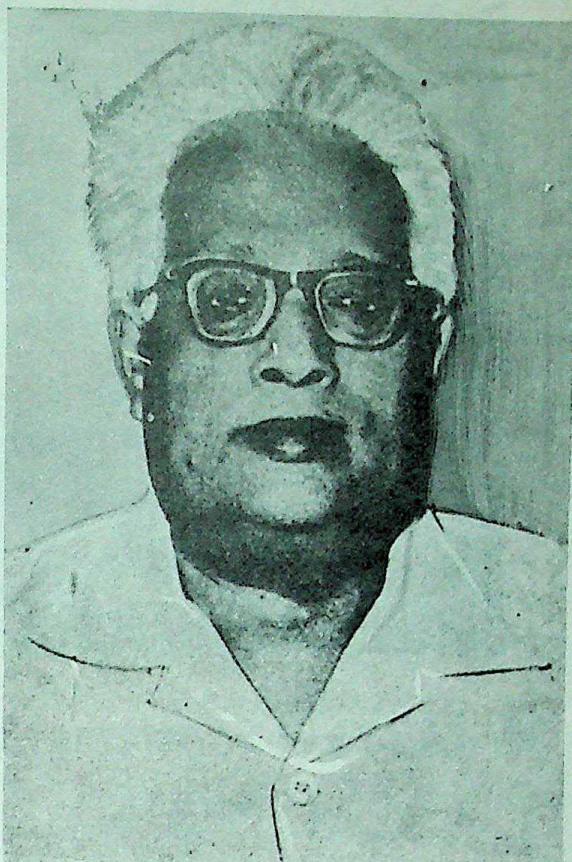
S.N. Bose was born in Calcutta on January 1, 1894. His father Surendranath Bose was a railway official. He went to Hindu School, Calcutta for his primary education. There is an interesting episode which offers a glimpse into his genius. In school he once got 110 marks out of 100 in the mathematics paper because he had solved some sums in more than one way. His teacher predicted that one day he would become a great mathematician.

After school he went to the Presidency College, Calcutta in 1909. Being the most brilliant student became favourite of almost all professors. He always stood first in the Intermediate, B.Sc. and in M.Sc. with applied mathematics.

In 1916, he was appointed a lecturer in Physics in the Science College of Calcutta University. There he, along with M.N. Saha, started postgraduate classes in Modern mathematics and Physics. He translated Einstein's original papers on relativity from German to English in 1915.

In 1921, Bose left Calcutta to join the Dacca University as a reader in Physics. In 1923, he submitted his magnum opus on the derivation of Planks equation to a British journal, the Philosophical Magazine. But unfortunately the referee did not recommend its publication and the paper was rejected. Bose sent this rejected paper to Einstein for his comments. In reply Einstein wrote a letter. He stated that this paper has an important contribution to make in mathematics. Einstein translated this work into German and got it published in 'Zeit fur Physik'. Bose's paper of 1924 made him a man of world fame and his name became associated with great scientist Einstein.

Bose went to Paris in 1924 on study leave to carry out some research under Madame Curie. There he spent ten months working for some time with Madame Curie and Louis de



SATYENDRANATH BOSE

Brogie. Bose sent another paper to Einstein which was translated by Einstein himself and published in 'Zeit fur Physik'. From Paris, Bose went to Berlin. Einstein accorded him a warm welcome. There he had discussions with the world's renowned scientists such as Plank, Schrodinger, Pauli, Heisenberg, Sommerfeld and Einstein himself. Bose had adopted Einstein as his Guru in the oriental tradition, though he never worked with him.

From Berlin he came back to Dacca and was appointed as Professor and Head of the Department of Physics. In 1945, he left Dacca and joined the University Science College in Calcutta as Khaira Professor of Physics. After his retirement in 1956 he was appointed as the vice-chancellor of the Visvabharati University (1956-58). In all he published around 24 papers on various aspects of Physics.

In 1962, he was invited to visit Japan to attend a conference on science and philosophy. After his retirement from Vishvabharati University he continued to devote his time to science and mathematics. In 1958 he was elected the Fellow of Royal Society of London. In the same year he was also awarded Padma Vibhusan by the Govt. of India. In the same year he became National Professor. On 4th February 1974 he died following a heart attack.



What were Sir J.C. Bose's contributions to Science in India?

In the 19th century although India was known for excelling in various fields like fine arts, literature and philosophy, her contribution in the field of science was almost negligible. It was Sir Jagdish Chandra Bose, who with his inventions not only made a name for himself but also put India on the science map of the world.

Bose was born on November 30, 1858, in a village of Bengal. After studying physics at the Calcutta University he went to England for further studies. He graduated from Cambridge University in 1884 and after coming back to India became professor of physical sciences at Presidency College, Calcutta (1885-1915).

He had a deep interest in animal and plant life right from his boyhood. After becoming the professor, he got an opportunity to work in this cherished field. He was the first to realise that both animals and plants have a great deal in common, but he did not have any instrument to prove it. To begin with, he designed and built a very sensitive machine for the detection of minute responses by living organisms to external stimuli. To begin with, he designed and built a very sensitive machine for the detection of minute responses by living organisms to external stimuli. This instrument was called 'crescograph'. It magnified the movement of plant tissues to ten thousand times of their original size and could record the reaction of plants to manures, noise and other stimuli. The crescograph indicated that plants have special sense. They respond to light rays and wireless waves. They are even sensitive to any strange approach to them. With the help of this instrument, he could establish many parallels between

animals and plants which was later proved by other biophysicists. His instrument was much praised in the Paris Congress of Science in 1900.

He was the author of two world-famous books : 'Response in the Living and Non-living' (1902); and 'The Nervous Mechanism of Plants' (1926).

Bose was a man of high self-respect and sound principles. An interesting incidence amply illustrates this point. He was appointed as a professor at a time when Indians were looked down by the Britishers. An Indian professor was paid only two-thirds the salary of an European professor. Bose's appointment was temporary, so he was given only half the salary of an European. For three years he did not touch any part of his salary. In the end the victory was his. He believed that Indians were in no way intellectually inferior to the Europeans. It was simply the question of facilities.

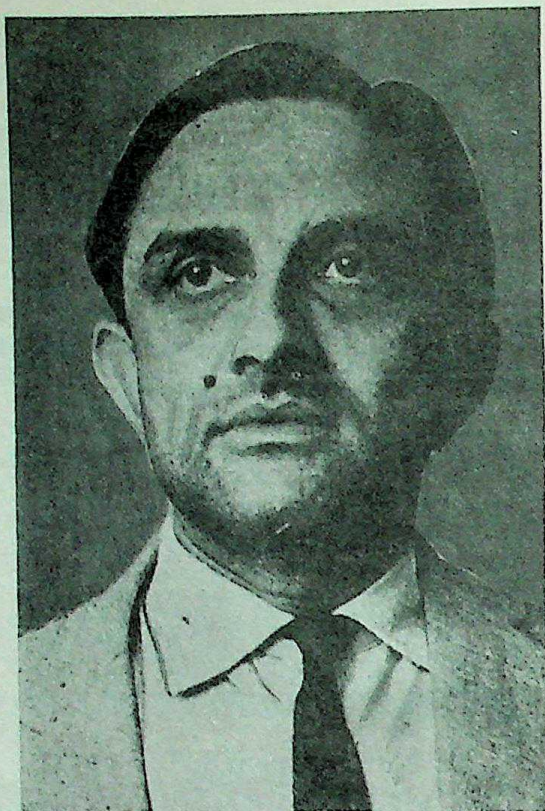
This great scientist of our country died on November 23, 1937.

What were Dr Vikram Sarabhai's contributions to science in India?

Dr. Vikram Sarabhai was not only an imaginative and creative scientist but also a pioneering industrialist and astute planner. He made significant contributions in the field of cosmic ray physics and in the development of nuclear power and space programmes. When Dr. Bhabha died in 1966, it seemed almost impossible to fill the vacuum but fortunately in Dr. Sarabhai a worthy successor could be found. He took up the nuclear programmes with a challenging spirit and also added fresh dimensions to the space research programmes.

Dr. Sarabhai was born on August 12, 1919 at Ahmedabad in a rich industrialist family. His early education was in a private school and Gujarat College at Ahmedabad. He then went to Cambridge, England and from St. John's College obtained his tripos in 1939. He then came back to India and started research work in the field of cosmic rays with Sir C.V. Raman at the Indian Institute of Science, Bangalore. In 1945 he went back to Cambridge to carry out further research on cosmic rays. There in 1947 he obtained Ph.D. degree in the same field.

It was as early as 1942, when Dr. Sarabhai and his newly-married wife, Sreemati Mrinalini, were staying for some time in Poona. There he conceived the idea of starting the Physical Research Laboratory in Ahmedabad. Soon after his return from Cambridge in 1947, Sarabhai started looking for a place for this project. He got few rooms at the M.G. Science Institute to start the laboratory. Prof. K.K. Ramanathan was made its first director in 1948. The foundation stone of the new laboratory building was laid in Feb. 1952 by Sir C.V. Raman and the laboratory was formally opened in April 1954. Dr. Sarabhai made the Physical Research Laboratory virtually the cradle of the Indian Space Programme just like the Tata Institute of Fundamental Research was one of the Indian Atomic Energy Programme.



VIKRAM AMBALAL SARABHAI

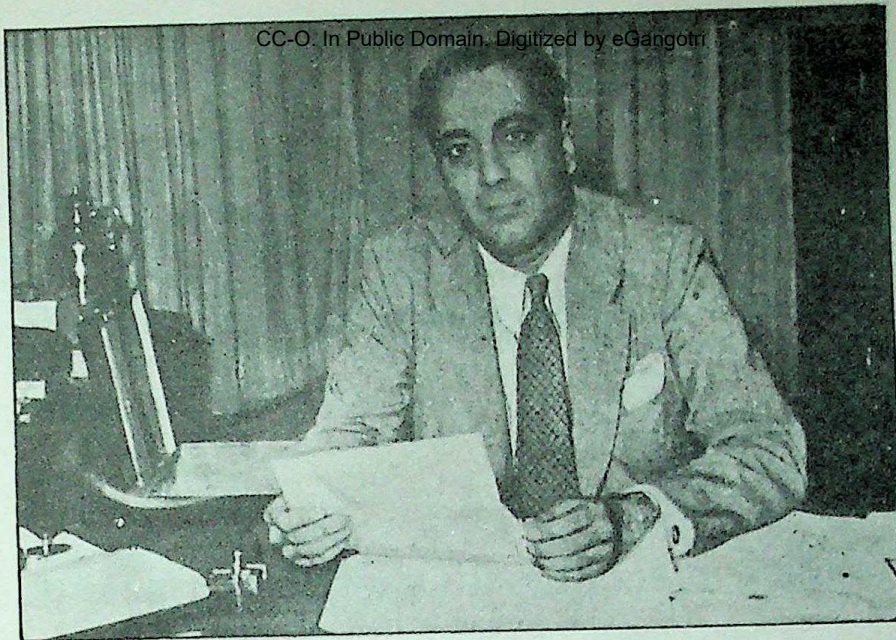
Dr. Sarabhai not only encouraged science but also devoted a good deal of time to industry also. For over 15 years he nurtured a pharmaceutical industry. He was also a pioneer of the pharmaceutical industry in India.

The first institution that Sarabhai helped to build was the Ahmedabad Textile Industry's Research Association (ATIRA). In building ATIRA he helped to introduce the scientific method in a traditional industry. He was only 28 when he was asked to organise and build ATIRA. From 1949-56 he remained an Honorary Director of ATIRA. In 1962 he helped to found the Indian Institute of Management at Ahmedabad. From 1962-1965 he remained an Honorary Director of this Institute. In 1966 after the death of Dr. Bhabha he became the Chairman of the Atomic Energy Commission.

Today the success of space programmes in our country are largely owing to the groundwork prepared by him in this regard. Dr. Homi Bhabha put India on the nuclear map of the world. Dr. Sarabhai did it in the field of space. Due to his efforts only India could launch its first satellite, Aryabhata just three-and-half years after his death.

As a result of his scientific achievements Dr. Sarabhai became a world renowned figure in the field of space research. He was Bhatnagar Memorial Award for Physics in 1962; Padma Bhushan in 1966 and posthumously Padma Vibhushan. He was selected the Vice-President and Chairman of the U.N. conference on peaceful uses of outer space in 1968. He also presided over the fourteenth General Conference of the International Atomic Energy Agency. Dr. Sarabhai died on December 30, 1971 at the age of 52 when he was at the peak of his achievements. It was a great loss to India and Indian science.

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HOMI JEHANGIR BHABHA

Who initiated India's atomic energy programme?

Homi Jehangir Bhabha was the first Chairman of India's Atomic Energy Commission. In fact, the atomic energy programme in our country was initiated by him only in 1948.

Dr. Bhabha was born on October 30, 1909 in Bombay in a wealthy Parsi family. He had his early education in Bombay. After graduating from Elphinstone College and the Royal Institute of Science in Bombay, he went to Cambridge University for further studies. From there he got his engineering degree in 1930 and a Ph.D. degree in 1934.

During his stay at Cambridge University, he worked with Niels Bohr on Quantum Theory. Later Bhabha worked with Walter Heitler in the field of Cosmic rays. He did significant work in identifying the elementary particles called mesons.

Bhabha returned to India in 1940 and was appointed as a reader and then a Professor of Physics at the Indian Institute of Science, Bangalore. There he started work on cosmic rays. In 1945, he founded the Tata Institute of Fundamental Research and became its Director. He remained its Director throughout his life.

Apart from being an eminent scientist he was also a skilled administrator. His scientific achievements, wealth and friendship with the Prime Minister, Jawahar Lal Nehru, enabled him to get government finances for atomic programmes and research. Bhabha became the first chairman of the Atomic Energy Commission of India in 1948.

Under his able guidance, Indian scientists worked on the development of atomic energy and the first atomic reactor (Apsara) in Asia went into operation at Trombay (Bombay) in 1956. Bhabha was Chairman of the first United Nations' Conference on the peaceful uses of Atomic Energy. It was held in Geneva in 1955. He advocated a check on the proliferation of Nuclear Energy and outlawing of atomic bombs by all countries. He was also offered a post in

the Cabinet which he refused. However, he continued to be the scientific adviser to Nehru and to his successor Lal Bahadur Shastri.

His work on atomic energy won him many honorary degrees of D.Sc. and Ph.D. both in India and abroad.

Dr. Bhabha died in an air accident on January 24, 1966 when he was going to attend an International conference. In his honour, Tata Institute of Fundamental Research was renamed as the Bhabha Institute of Fundamental Research. He will always be remembered as the architect of India's atomic energy programme.

What is gyroscope and when was it invented?

The first gyroscope was devised by a German, G. C. Bohmenberger in about 1810. But it was named thus by a French Physicist Leon Foucault in 1852, when he used the device to demonstrate the rotation of the earth. Its name has its origin in two Greek words: 'gyros' means turn or revolution; and 'skopein' means 'to view'. Therefore, gyroscope means, "to view the turning".

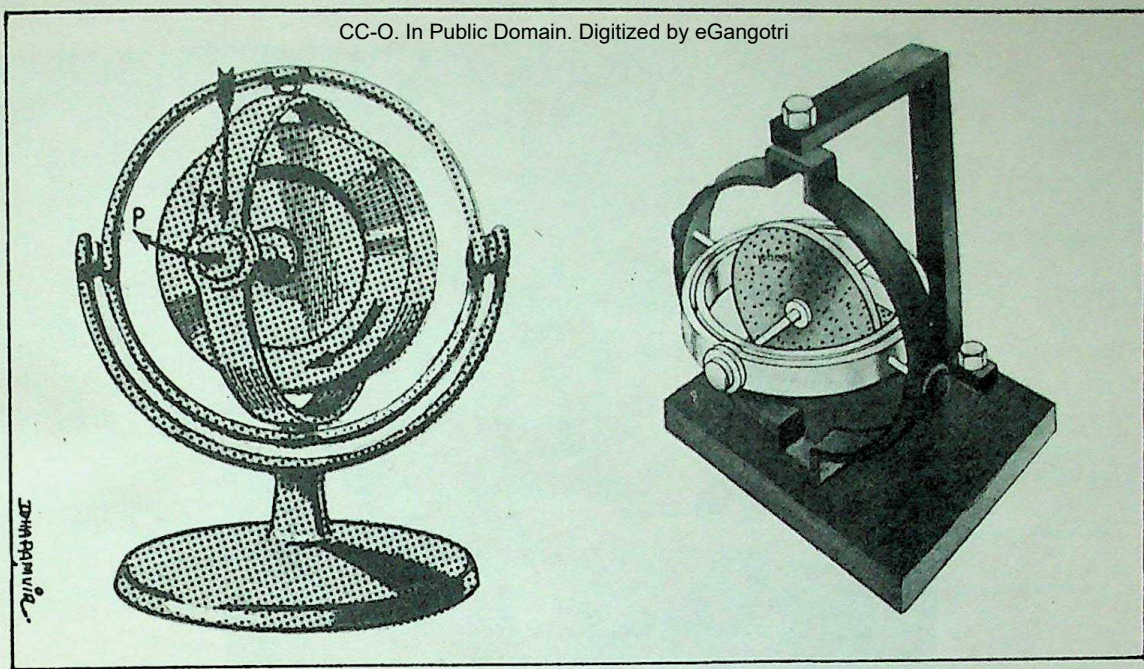
This instrument is based on the same principle as that of a spinning top. We know that as long as the top keeps rotating it remains upright and resists the force of gravitation. Similarly in a gyroscope a wheel is mounted at such an angle to the rest of the apparatus that it is free to revolve round any axis.

According to the basic principles of motion any spinning object resists an attempt to change the direction of its axis—the imaginary straight line round which it revolves. Thus you can move a gyroscope up, down, forward, sideways or backwards, and feel no resistance. But the moment you try to turn it through an angle you will meet opposition.

A gyroscope basically has a heavy wheel. Most of its weight is concentrated in the rim. This gives the wheel a large amount of inertia. It resists attempts to change its position. If an attempt is made to tilt its axis, it will start moving in another direction, in a circle. This is known as precession.

Gyroscope serves a very vital function in navigation. It is used to pilot the airplanes and ships. Ordinary compasses rely on the earth's magnetic field to point out the right directions. But the earth's magnetism varies from place to place. And so the magnetic compasses are not fully reliable. In fact, they are extremely misleading near the North and South Poles. Here again gyroscope serves a useful purpose. It's not affected by the earth's magnetism. There are several types of gyrocompass. They are used together with magnetic compasses for navigation.

Ships and submarines have marine gyrocompasses. These have specially weighted frames. The weight acts at right angles to the axis of the gyroscope. The axis is set to point toward the earth's geographical North Pole. No matter what direction the ship takes, the axis



always points towards the north. And this helps the navigator to set the ship's course accurately by the axis.

Aircraft may have several gyroscopic devices. One of the major ones is the directional gyro. It is used for navigation along with a magnetic compass. The other important device is called the artificial horizon. It has a vertically mounted gyroscope. Whatever be the position of plane it would always accurately point in the 'up' and 'down' direction. A directional gyro and an artificial horizon are used in an automatic pilot system in many airplanes.

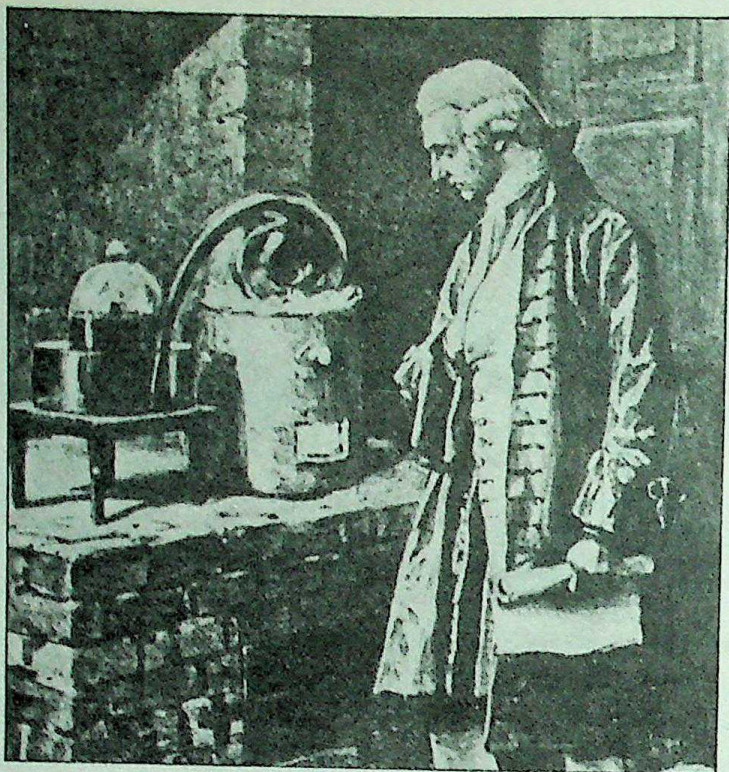
Gyroscopes are also useful to prevent ships from rolling. These gyroscopes are called gyrostabilizers. They resist the rolling movement and keep the ship steady.

In most gyroscopes, electric motors keep the rotors spinning. Smaller gyroscopes may be driven by jets of air blowing on the rim of the rotors.

Who is called the father of modern chemistry?

The great French chemist, Antoine Lavoisier made so many important discoveries that he is called, 'the father of modern chemistry'. This great scientist was born on August 26, 1746 in Paris. After completing his education, he first became a lawyer and worked as a tax collector. In his spare time he did research.

In 1766, he won a gold medal for his suggestions on how to light the streets of Paris. He was later given the job of gunpowder officer. Lavoisier did a great deal of research on



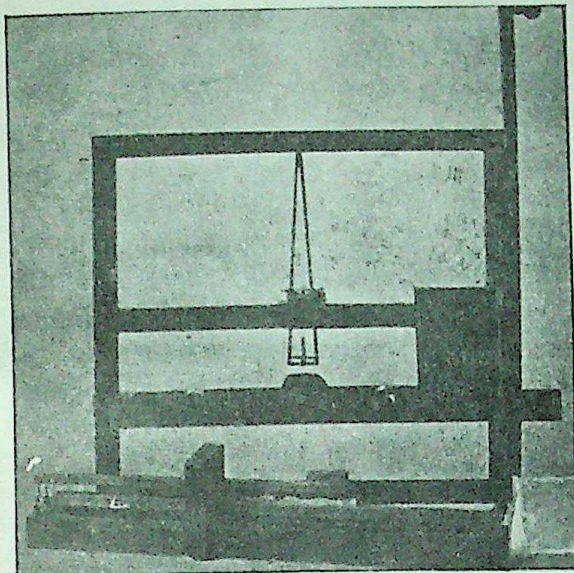
combustion. In 1772, he proved through experiment that the ash from burnt metals is heavier than the original metals. Earlier people believed that when burnt such things gave off a substance called phlogiston. Lavoisier proved that during the process of burning something was added to the substance.

After the discovery of oxygen by Joseph Priestley in 1734, Lavoisier proved that air contains two gases. He maintained that the one called oxygen helped in combustion and breathing. The other gas did not support combustion and was named azote by him. It is now called nitrogen.

Lavoisier made many other important discoveries. He gave to the science 'the law of conservation of matter'. He also performed research on the nature of chemical reactions. The system he devised to name the chemical compounds is still in practice. He published his major discoveries in a book called "Elementary Treatise on Chemistry". This book contained the first published table of chemical elements.

He successfully demonstrated the advantages of scientific agriculture and planned improvements in the social and economic condition of the province of Orleans. He was nominated a member of the commission formed to secure uniformity of weights and measures throughout France. It was the report of this commission that led to the adoption of the metric system.

After the French Revolution of 1789, Lavoisier was willing to help the government. But because of his political leanings and his job as a tax collector with the earlier government, he was put to death by guillotin on May 8, 1794.



THE INTERNATIONAL MORSE CODE

a	b	c	d	e	f
g	h	i	j	k	
l	m	n	o	p	
q	r	s	t	u	
v	w	x	y		
z					
Numerals					
1	2	3			
4	5	6	7		
8	9	0			

When was Morse Code first used?

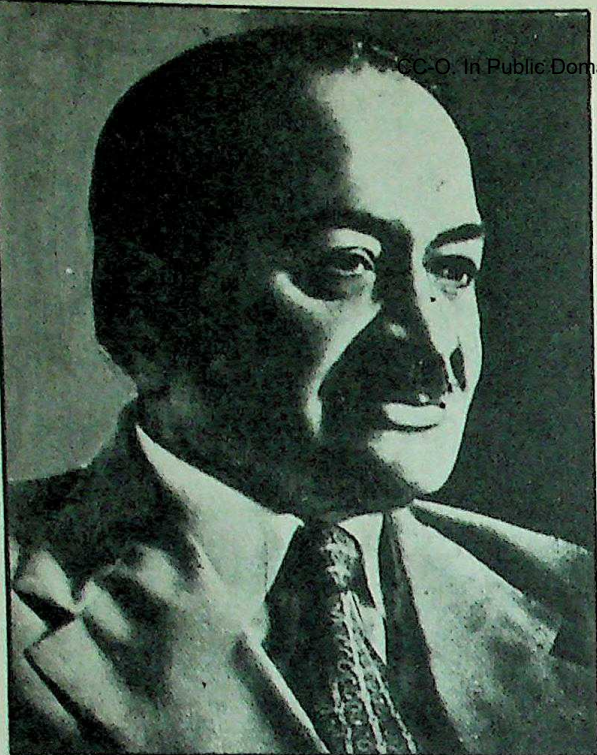
Morse code is a system of sounds that telegraphers and radio operators use to send messages through wire or radio. This involves a system of dots (short signals), dashes (long signals) and spaces. Each letter of the alphabet, plus numbers and other symbols, are represented by groups of dots and dashes (see fig. above). The Morse code is named after Samuel Morse, of USA who developed it in 1938. He also patented the telegraph in 1840 and was credited with the invention of telegraph.

The first message in Morse code was taped out in the United States over a telegraph line from Baltimore to Washington, by Samuel Morse on May 24, 1844. The message was, "What hath God wrought".

In 1837 Morse exhibited his first successful telegraph instrument. By 1838 he had developed the Morse code. But it was not until 1843 that Morse build the first telegraph line in the United States from Baltimore to Washington. In the following year i.e. 1844, he succeeded in sending the first message.

Telegraph messages are sent by pressing down on a telegraph key. The dot is made by pressing down the key and releasing it quickly. This produces a rapid "click-clack" sound in the receiver at the other end of the wire or the radio receiver. In the case of radio telegraph, the sound is more like a musical note. A short dash is sounded by proceeding the 'dot' twice. A long dash is equal to four dots. The space between letters is sounded by 'three dots'. A space that is part of a letter combination equals two dots.

Even today in many countries, all telegraph messages and many new items are being transmitted by Morse code. Today most of the telegraph messages are sent by automatic printing telegraph machines called teleprinters, and by automatic facsimile.



SHANTI SARUP BHATNAGAR, KT, D.SC., F.R.S.

What is Shanti Swarup Bhatnagar Award?

Shanti Swarup Bhatnagar Memorial Award is given every year for outstanding research by the Council of Scientific and Industrial Research. It was started in the honour of its first Director General Dr. Shanti Swarup Bhatnagar in 1958. The awards are given in the fields of Physical Sciences, Chemical Sciences, Biological Sciences, Engineering, Medical and Mathematics (alternate years). Each award carries a cash prize of Rs. 10,000 and a certificate.

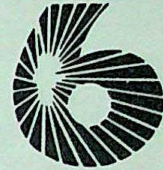
Shanti Swarup Bhatnagar was a renowned Indian chemist. He was born on Feb. 21, 1894 at Bhera in West Punjab. He obtained his M.Sc. from the Punjab University in 1919. After taking his D.Sc. from London University under Prof. Donan, he worked under Prof. Haber at Kaiser Wilhelm Institute, Berlin and later under Prof. Freundlich, an expert on Colloids.

He was a Professor of Chemistry at Banaras Hindu University from 1921-24. From 1924-40 he worked as Director of the University Chemical Laboratories, Lahore. There he made significant contributions in the field of physical chemistry, especially in magneto-chemical studies. He also wrote a book on magneto-chemistry.

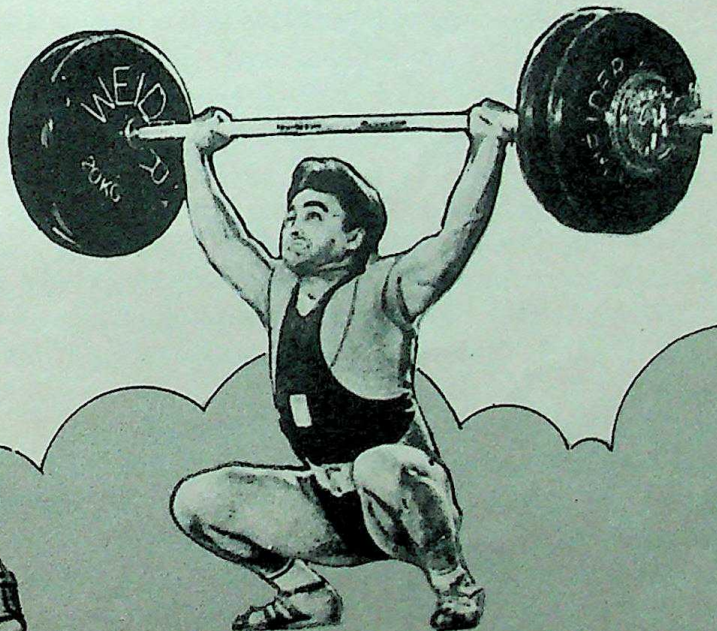
He became the first Director of Council of Scientific and Industrial Research in 1940 and held this post till his death. In 1943 he was made a Fellow of the Royal Society of London. In the same year the Secretary of the Royal Society Prof. A.V. Hill visited India to advise the government on the coordination of scientific research in India. Dr. Bhatnagar was one of the members in the meeting along with Hill, Saha and Bhabha.

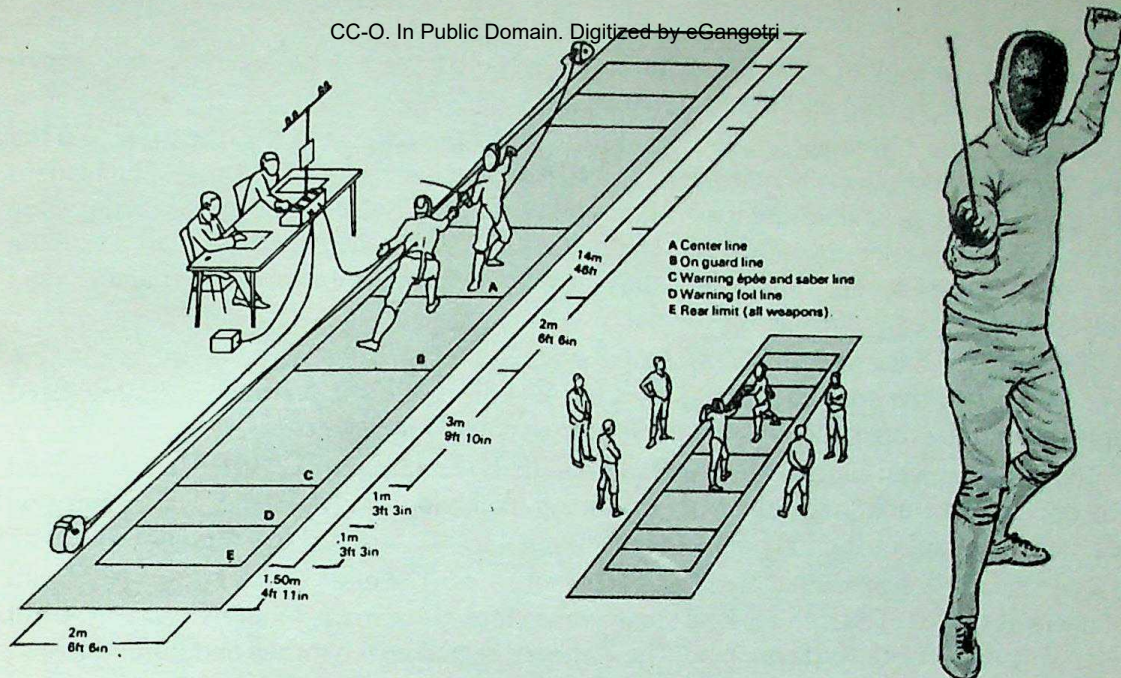
In 1946, when Pt. Nehru was the head of the Interim Government Dr. Bhatnagar took up his views on science development in India to translate them into reality. He concentrated on applied sciences and managed to get substantial funds from industrialists for the building up of research laboratories. He opened a chain of National Research Laboratories in India.

This great scientist died on Jan. 1, 1955. After his death, Bhatnagar Memorial Award was instituted in his honour.



SPORTS





What is the sport of Fencing?

Fencing is a sport involving the skilful use of swords for attack or defence according to set rules and regulations. In France it is called 'Escrime' and in Italy 'Schoma'. It has a long and fascinating history, and its roots can be traced to the traditions of chivalry.

The sport has been a permanent feature of every Olympic Games ever since their revival in Athens in 1896, and today it is increasingly practised throughout the world.

The fencing is divided into the three major branches depending upon the weapons employed. The three different types of weapons used are: foils, sabres and epees. The fencer score points by touching a target area on the opponent and loses when touched by the opponent.

Some of the main advantages of this sport are that it provides concentrated physical exercise in a short duration of time independent of weather and without excessive cost. Moreover there is no need of a large number of players or expensive venues or apparatus. It develops a co-ordination of mind and body. It is a game of skill speed and finesse in which the brute strength doesn't have much role to play. It is suitable for both men and women. It is a complex and difficult art to master.

The fencing equipment is relatively inexpensive. This requires a fencing jacket, a mask, a glove, a foil or other weapon, with trousers or fencing breeches, white stockings and rubber-sole gym shoes or flat sole fencing shoes.

The fencers weapon consists of a blade and mounting. The stronger half of the blade, which is nearer to the guard, is called the forte and the remainder, the foible (see fig). The mounting consists of the guard, the form of which varies according to the weapon and

within which there is often a small cushion to protect the fingers. It has a handle or grip with which the weapon is held and manipulated.

The modern art of fencing is practised with three weapons: the foil, the epee and the sabre. The foil is just over one metre long (1.1 metre) and weighs upto 500 gms. The blade is rectangular, tapering, flexible and has a blunt point called the button. The epee is of the same length as foil but heavier upto 700 gms. The blade is triangular and rigid. The sabre is of the same weight as the foil but little shorter (1.05 metres). The blade is V-shaped and narrow, rigid at the cutting edges but flexible on the flat.

The foil is the basic weapon with which the art of fencing is learned. However, later the fencer may prefer the epee or sabre. This is because the foil is the most easily manipulated weapon among the three and enables the fencer to carry out all fencing movements with it.

The target area on which a hit is valid varies with the weapon. In case of foil, it is restricted to the opponent's trunk, back and front excluding the head, arms and legs. The hit must be made with the point of the foil only and is valid only if they land on the target.

The foil is held and manipulated with the fingers only. The epee is also manipulated with the fingers as the foil. The sabre is held somewhat differently than the other two weapons, but it is similarly manipulated by finger play. The blade is directed by the thumb and the first finger, but these movements are assisted by the little finger.

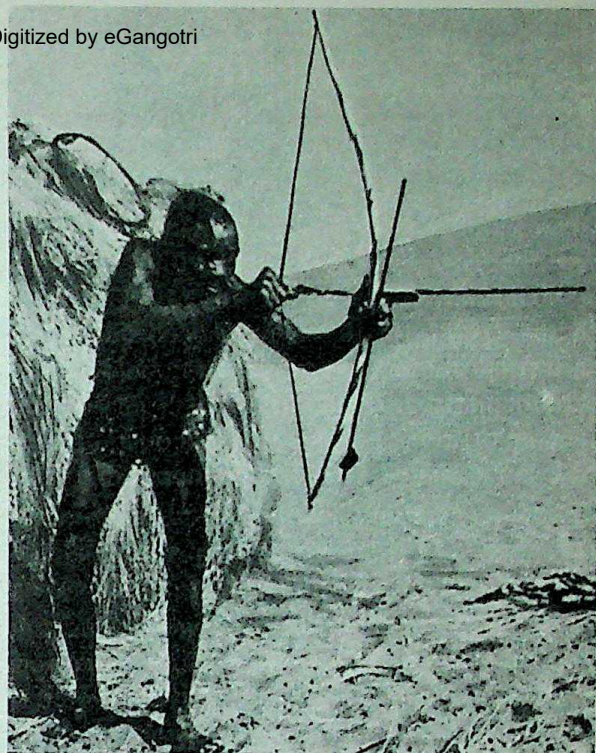
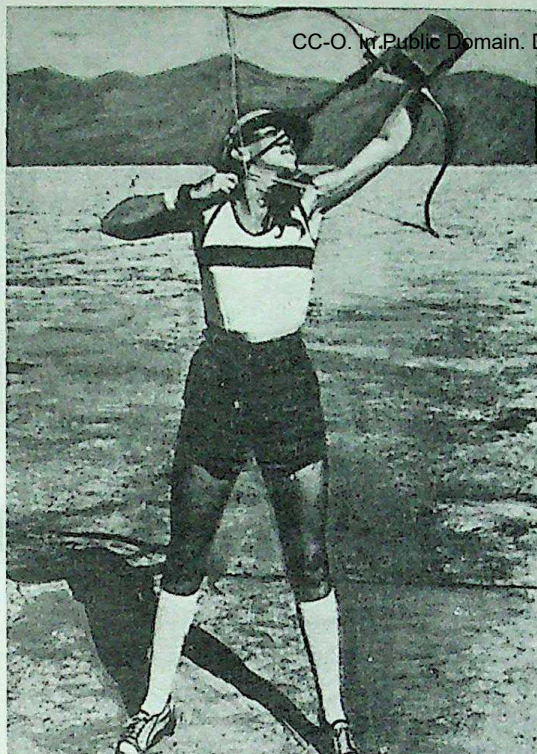
A bout between men at foil, epee or sabre is fenced for five hits (best of nine hits). However, in case of women foil, a bout is four hits. The time limit for a bout is six minutes of actual fencing time for men and five minutes for women.

Judging a fencing competition requires great experience because of the complexity and speed of movements and the constant mobility of the competitors. The foil and epee competitions are judged by an electrical judging apparatus that registers the time of the hit. No electrical apparatus is used for judging sabre. This calls for two pairs of judges to judge the game. The hits are awarded according to the rules and conventions applicable to sabre fencing.

When did archery start?

Archery or shooting arrows with a bow is one of the oldest skills practised by man. From the pre-historic times, bow has been a principal weapon of war and hunting. Though the bow lost its use in war in the 15th century, it was retained as a hunting weapon and as a versatile instrument for other kinds of agreeable pass-time. Archery as an organised sport appears to have developed in the 3rd century A.D.

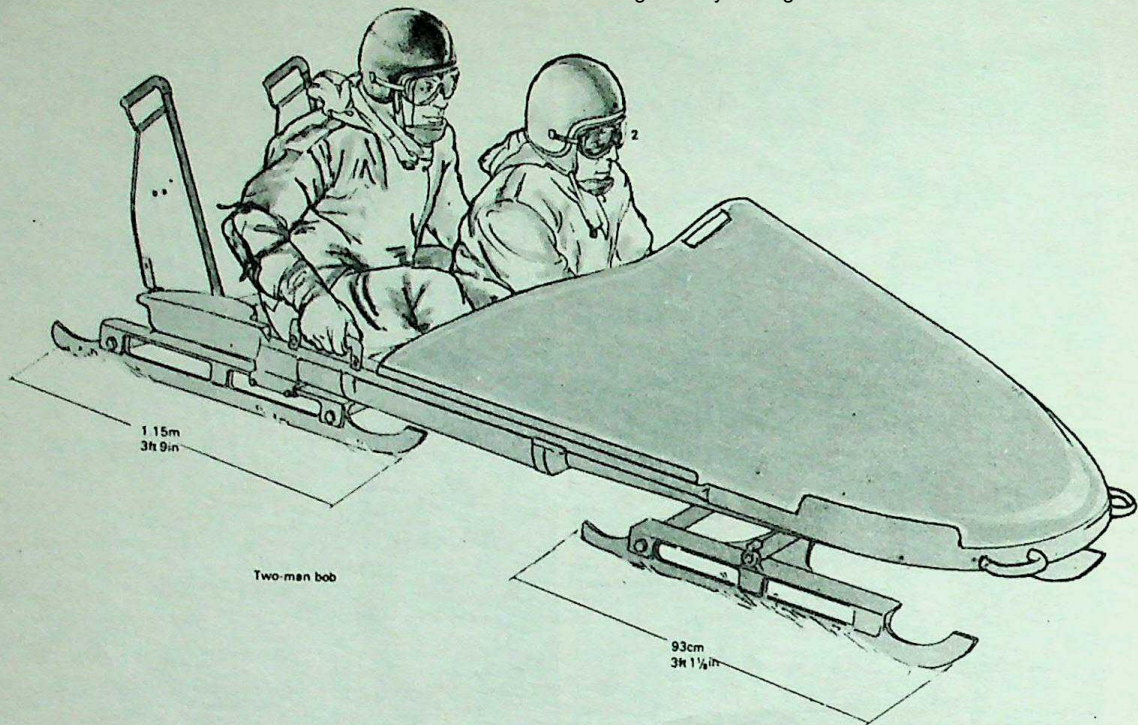
Initially bows were made of a single material, usually wood. Later many other materials along with the wood were used for them. These were called composite bows. After 1950s, crossbow has been used as a sport implement. Similarly many changes were also made in the



bow strings. Bowstring materials include animal and vegetable fibres, hemp, silk, linen, twisted gut, strips of hide bamboo or rattan. Arrows have emerged in slow evolution. The earlier arrows used were probably made of some form of reed or cane. With the development of tools wood from straight-grained trees could be used for the purpose. Metal or stone heads were attached for penetration. When iron and steel became available, a variety of designs of arrows were developed.

The idea of archery as an organised modern sport started with the development of longbow. International competition in target archery began only with Anglo-French matches at Le Touquet before World War I. In 1931, International Archery Federation was formed to conduct world championship matches. In the world championship matches, the longest distance for men is 90 m (98.4 yds) and for women 70 m (76.5 yds). Because of the growing international interest in the sport, field archery was included in the world championships in 1969. Under the international field archery rules, the metric system is used and the longest shot is from 60 m (65.6 yds) and the largest of the four target sizes is 60 cm.

Competitive target archery had become a popular amateur sport in Europe in the first-third of the 20th century. And from 1931, through 1950, international competitions were dominated by archers from France, Belgium, Sweden, Poland, the U.K. and Czechoslovakia. Archery events were included in the Olympics of 1900, 1904, 1908 and 1920. This sport was again included as official sport in 1972 Olympic games.



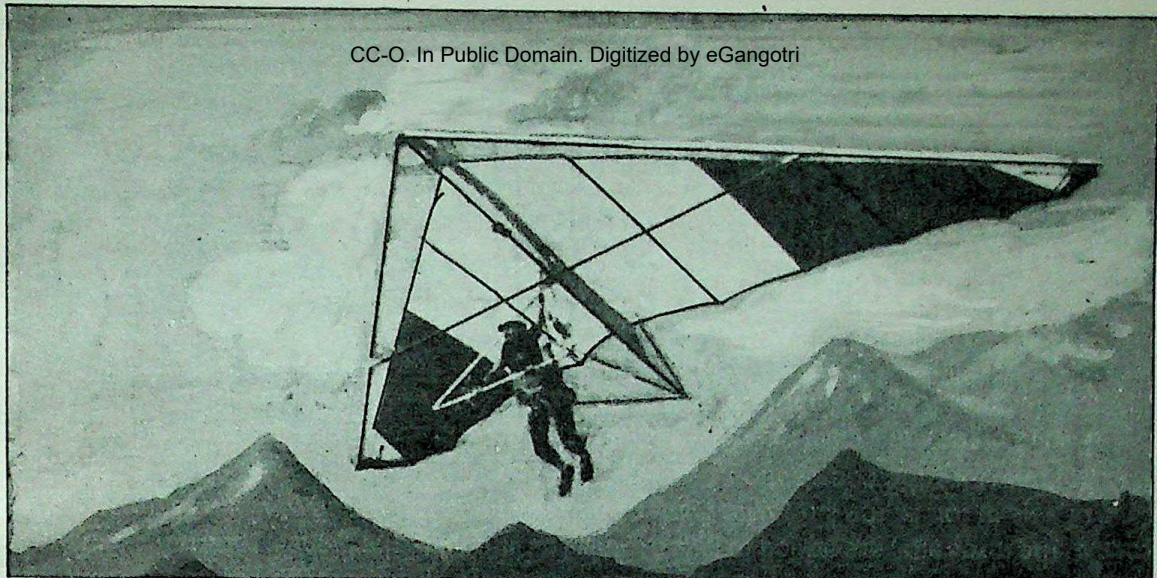
What is the sport of Ice-Boating?

Ice-boating is a favourite sport of the Scandinavian countries such as Norway, Sweden, Denmark, Finland and the USA and Canada. It involves sailing and racing on ice-boats. It is one of the winter sports. The Dutch seem to have been the first to take to this sport. A sketch (painting) dating back to 1768 shows a typical sloop-rigged Dutch sailboat with a cross plank under the hull near the bow, a runner at each end, and a sharp iron shoe at the stern on the bottom of the boat's regular rudder.

An ice-boat is a narrow, pointed sailboat that sails on ice instead of on water. It can do this because it rests on runners—usually three. They look something like short skis. It's sails are usually very large. And these help the ice-boat to catch wind and move ahead.

The ice boat can reach several times the speed of the wind propelling it by sailing across the wind and not being pushed along by it. It can attain the speed of more than 140 miles per hour.

It was towards the middle of the 19th century that interest in this sport increased. By 1900 the fleet of the Hudson River Ice Yacht Club had managed to muster over 50 ice-boats, including 6 giant-sized ones with more than 600 square feet of sail. By the World War II, European ice-boating had become very active and well-organised under the European Ice Yachting Union. The member nations included Sweden, Latvia, Estonia, Germany and Austria. Competitions were held annually in several classes and a one-design class of 15 square metres sail area. Rigs were almost universally single-sail. However, after the World War II the sport took some time to be revived again. By the 70s over 1500 boats were registered in the U.S., Canada and Europe.



What is the sport of Hang gliding?

Hang gliding is a popular American sport today. Hang glider looks something like a huge kite. It is shaped like a triangle. (see figure above). At its widest point, a glider is about as wide as the length of a car. The flier wears a harness attached to a glider. He holds onto the glider and races down a hill into the wind or else jumps off a cliff. The wind lifts the glider into the air. The pilot uses a control bar to change the directions.

A hang glider usually travels as fast as a car would on a busy street. A person learning to hang glide usually flies 3 to 6 metres above the earth. After a training, the pilot might go much higher. The hang gliders never fly as high as airplanes.

Though many men have contributed to the development of the glider, the pioneer was a German Otto Lilienthal (1848-96). Along with his brother Gustav. He began experimenting in this direction in 1867 on the buoyancy and resistance of air. After a lot of experiments he succeeded in 1891 in making his first man-carrying craft, with which he could take off by running downhill into the wind. He made numerous flights between 1893 and 1896.

This was the beginning. After this many developments were made in the design of gliders by Octave Chanute (French-born American Engineer), Orville and Wilbur Wright etc. In the 1950s Professor Francis Rogallo of the National Space Agency, USA relying on his space capsule re-entry researches, developed a wing.

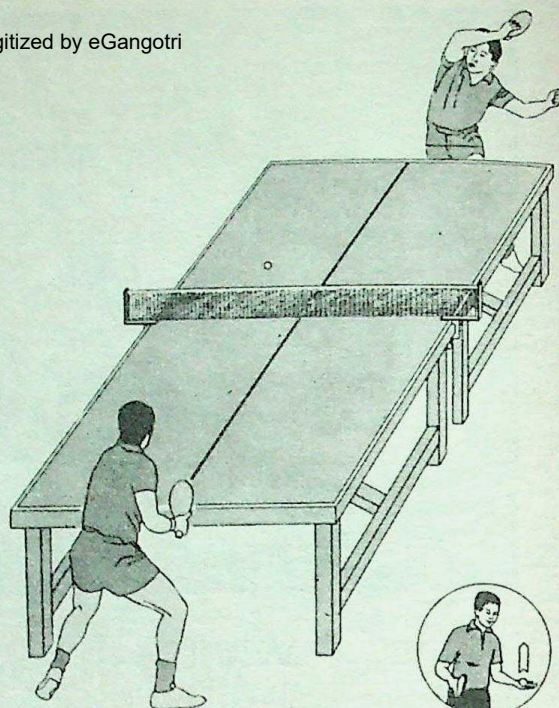
In the case of most of the early gliders, flying speed was very low. Normal practice was to fly into a wind so that the actual acceleration required was not too much. Today's favoured launching techniques are the airplane tow and the automobile tow. The tow rope is usually 60 m long with a steel ring attached at each end, fitting the tow hooks with the towing vehicle and the glider.

Many records of long distance gliding and of greatest altitude gliding have been set in the world.

Since 1935 hang gliding has reputation as tools for aeronautical and meteorological research.

Where did Table Tennis originated?

Table Tennis is an indoor game played on a table with a lightweight ball. The table is divided into two equal courts by a net fixed across its width at the middle. The ball is made of celluloid or plastic. It is propelled back and forth across the net by small rackets (bats or paddles) held by the players. It is a popular game all over the world especially in Europe and Asia. Do you know where this game was invented?



It was invented in England in the early years of the 20th century. Originally it was called 'ping pong'. The name 'table tennis' was adopted in 1921-22. The International Table Tennis Federation was founded in 1926. The founder members were England, Sweden, Hungary, India, Denmark, Germany, Czechoslovakia, Austria and Wales. By the 1970s, more than 90 national associations were members and there were six continental Federations: Europe, Asia, Africa, North America, South America and Oceania.

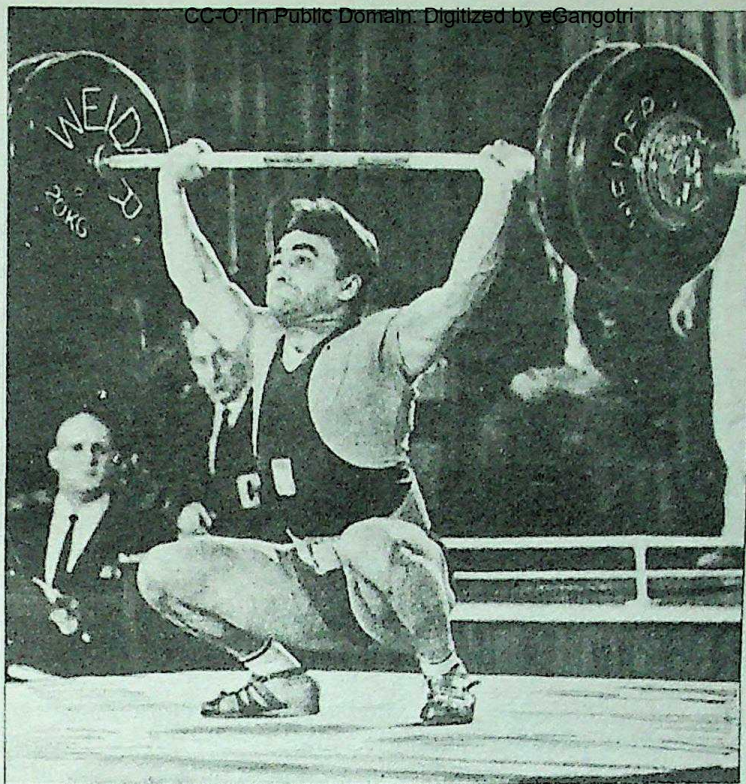
The first world championships were held in London in 1927 and from then until 1939 the game dominated by players from the central Europe. Hungary and Czechoslovakia produced some of the greatest players of the game. However, by the mid 50s Asia began to take over. In 1954-56 the Asians became the champions.

This is a game played by both men and women. The table on which it is played measures 2.47 m long and 1.52 m wide. Its upper surface has to be 76 cm above the floor. The net is 1.83 m long and its upper edge along the whole length is 15.25 cm above the playing surface. Ball, made of plastic, weighs 2.5 gm and has a diameter of 3.81 cm. The racket or bat is of wood, flat and rigid and may be plain uncover wood or wood covered with a thin layer of rubber.

A match consists of the best three or the best of five games. Each game is won by the player who first reaches 21 points or who after at tie at 20 points wins two points without break. A point is scored when the server fails to make a good service, when either player fails to make a good return or when either player touches the playing surface with his free hand while the ball is in play. Service changes hands after every five points until 20 all is reached then it changes after every subsequent point.

The serve is made from behind the end of the table, the serve projecting the ball upward from the palm of his free hand and striking it as it ascends so that it first touches his own court and then, passing over the net, touches his opponent's court.

In the single game there is a contest between one player at each side and in the doubles two players at each end. The doubles may just between men, women or mixed.



When did the sport of weightlifting start?

Throughout the human history, man has shown a penchant for displaying his physical strength and prowess. For many prehistoric tribes the true test of manhood was to lift some special rock. Many such stones, with inscriptions of athlete's names who first lifted them, can still be found in Greece and Scottish castles. Stone-throwing competitions survive in West Germany and Switzerland and rock lifting is still popular in the Basque region of Spain.

The modern weightlifting began in the late 18th and 19th centuries, fostered by the feats of professional strongmen such as Eugene Sandow and Arthu Saxon of Germany, George Hackenschmidt of Russia, Louis Apollon of France and others who performed in Circuses and music halls.

The first open world championship were held at the Cafe Monico, London in 1891 and won by the Englishman Lawrence Levy. Two weightlifting competitions were included in the first rival Olympic Games held in Athens in 1896. The winner of the one hand lift competition was Launceston Elliot of Great Britain who lifted a 71 kg weight. And the winner of the two-hand lift competition was Viggo Jensen of Denmark who lifted 111 kg weight.

The one and two-hand events were held again in 1904 and then in 1920. However later at the suggestion of the International Olympic Committee, the International Weightlifting Federation was formed to control the sport and to formulate technical rules. Since then the weightlifting has been included in the Olympic Games. The international federation originally included 14 member countries, but in the mid 1970s this number had risen to 100. France and Germany were the leaders in his sport upto 1930s. But then Egypt took over as the leader

After the World War II the U.S.A. remained supreme until 1953. Since then Soviet Union have held most of the world records.

The weight used in modern weightlifting is a rod which cast-iron disk weights are fastened at each end on a revolving sleeve. The individual weights include discs of 25 kg, 15 kg, 10 kg, 5 kg, 2.5 kg, and 1.25 kg. The lifts are performed on a wooden platform 4 mts square. And if lifter steps off this platform during the course of a lift, that lift is not counted in score.

To begin with there were five bodyweight categories but now we have nine. They are: flyweight, 52 kg; bantamweight, 56 kg; featherweight, 60 kg; lightweight, 67.5 kg; middleweight, 75 kg; light heavyweight, 82.5 kg; middle heavyweight 90 kg; heavyweight 110 kg; and super heavyweight, over 110 kg. Originally the international weightlifting federation competitions had five different competitive categories. But these were reduced to three in 1928 and finally to two in 1972.

The lifter first lifts the barbell to his shoulders in a single jerk. He may move his feet to do this. When he is standing erect, the chief referee gives him a signal to complete the lift, which he does by pressing the barbell in a steady continuous movement to arm's length overhead without any assistance from legs.

The competition begins at the lowest weight specified by the lifter and the weight of the barbell is increased in multiples of 2.5 kg. Each lifter takes his turn as required but is allowed only three attempts on each of the three lifts. The increase in weight from first to the second attempt must be at least 5 kg and from the second to third at least 2.5 kg. The best of a lifter, on each of the three lifts, are added to give a total. The lifter with the highest total is the winner. In case of a tie in totals, the lifter with lighter body weight is the winner. All lifters are weighed 1.25 hours before the competition begins.

Two referees and a chief referee adjudicate the lifts and signal their decisions by means of a system of lights. A white light indicates, a 'good lift' and a red light, 'no lift'.

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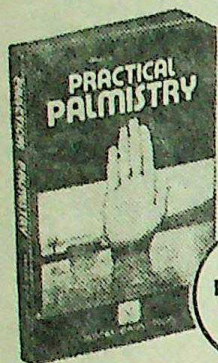
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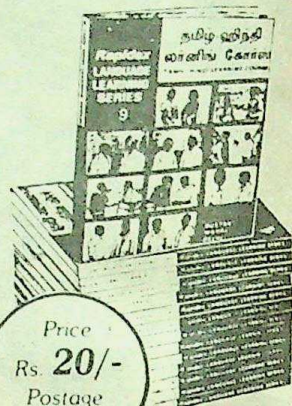
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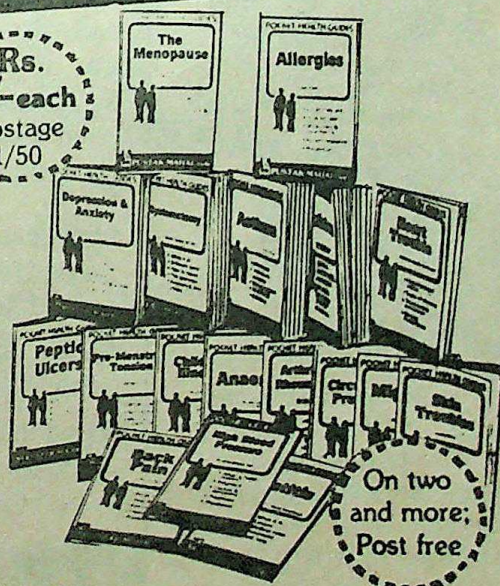
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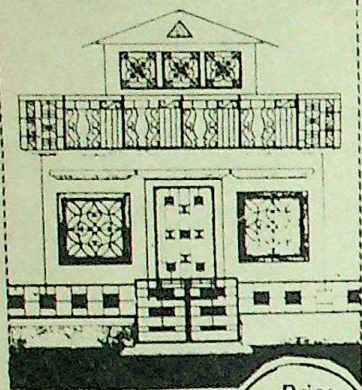
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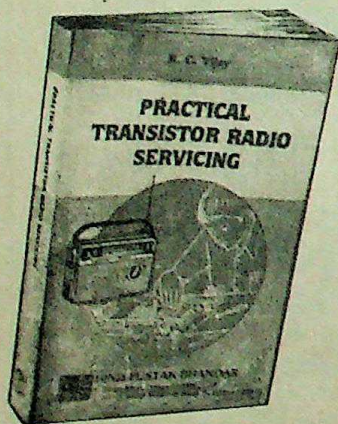
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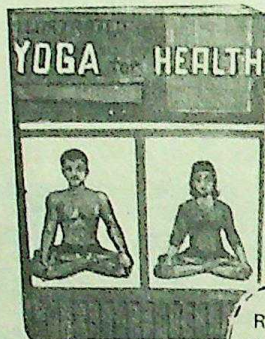
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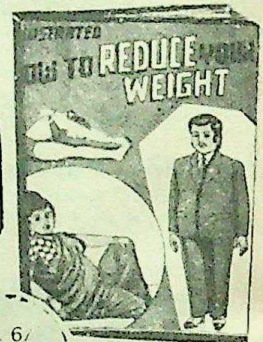
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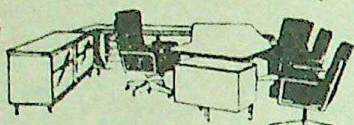
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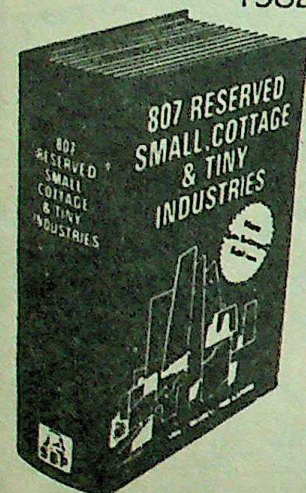
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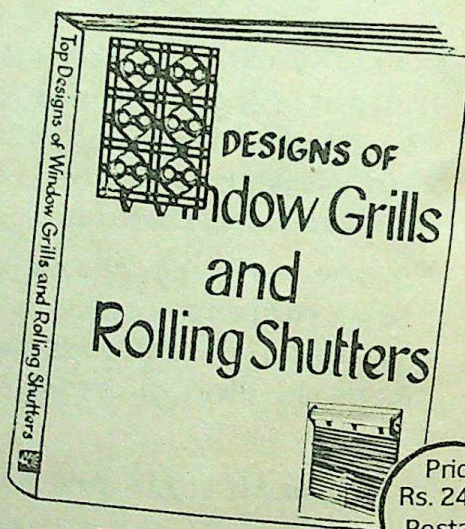
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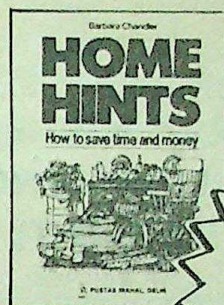
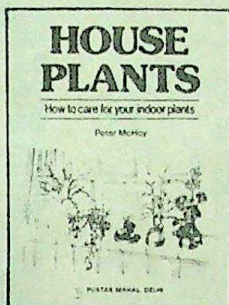
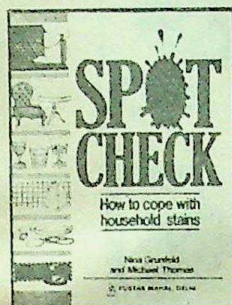
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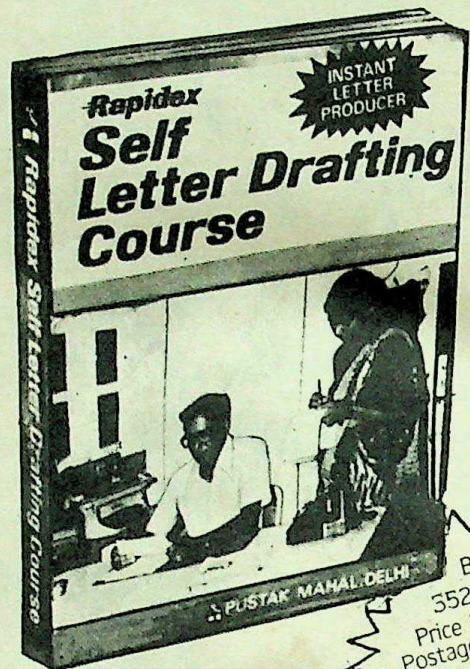
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